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NATURALIST AND GEOLOGIST.

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ARTICLE I.—*On the* Cornus florida *of the United States.* By George S. Blackie, A. M., M. D., and Professor of Botany and Natural History, University of Nashville, Tennessee, U.S., Honorary Member of the Botanical Society of Canada.

[*Read before the Botanical Society by Professor Williamson, LL.D., Kingston,* 11*th January*, 1861.]

Common throughout all our forests, conspicuous in spring time by its festoons of large white blossoms, and equally so during the fall months from its clusters of scarlet berries, a handsome little tree usually about 15 to 30 feet high, is the *Cornus florida* L. of the United States. I have brought this plant to your notice for no particular reason, but that it this morning attracted my attention, as I walked in the neighbourhood of my home, and I conceive that much service may be done to the existing state of the botanical knowledge of our country, should each member of the society take up, meeting after meeting, some individual plant, no matter how common, and state all that he knows of that plant, whether such information be gleaned from his own studies or from those of others. On my first visit to the United States, one of the first objects which attracted my attention on travelling down the Mississippi, from the snows of Canada to the balmy spring of Louisiana, was this plant, and its extreme beauty, con-

trasted with the gloominess of the scenery from which I had just emerged, made so strong an impression on me, that I have ever since regarded the plant with a peculiar interest.

Cornus florida is probably the most generally distributed species of its genus in our country. In this genus, which is one of the family of *Cornaceæ*, there are about twenty species, of which America has, north of Mexico, eleven; two are peculiar to Mexico; three are found in Nepaul; two in Japan; two are found in both Europe and Asia, and one is found in the north of both hemispheres. They are all shrubs, with entire, deciduous leaves, covered with adpressed hairs, the calyx four toothed, minute, adhering to the ovary; the petals four, distinct, oblong, inserted with the calyx into an epigynous disk, drupes baccate, flowers in cymes. In this State (Tennessee) we have at least five species; *C. paniculata*, *C. stricta*, *C. asperifolia*, *C. sericea*, and the subject of my present paper. In addition to these, in the north there are the species *C. Canadensis*, *C. circinnata*, *C. alba*, *C. alternifolia*, and *C. sanguinea.* The property of the bark of all these is very bitter and tonic. Some of them have underground stems, which send up branches dying annually down, others again have true permanent stems, the wood of which is excessively hard, a fact which has given rise to the name, from the Latin *Cornu*, a horn, the wood being believed to be as hard and as durable as horn. Hence the ancient Romans constructed spear-shafts and other warlike instruments from it, and Virgil alluded to it as *bona belli cornus.* The wood of *C. florida* is not only remarkable for its hardness, but for its extremely fine texture.

Cornus florida, the flowering dogwood, is the most beautiful and showy plant of its genus. It is a round-headed small tree, usually fifteen or twenty feet high, but often reaching a height of twenty-five or thirty feet, and its stem a diameter of eight or nine inches. The new shoots are of grayish green, covered with down, those of the previous year are purple with slight rings, afterwards changing to gray and streaked with brown. The stem is rough, with short broken ridges, between which the bark is often divided into regular plates. The branches are numerous, spreading, and disposed with regularity, sometimes opposite, sometimes arising by fours. The leaves are three inches long, opposite, oval, entire, acuminated, and, at the base, abruptly tapering to a short channelled footstalk. Smooth on their upper surface, their lower is whitish, with hairs along the mid-ribs and veins, and a few

scattered ones between, the upper surfaces having also numerous conspicuous ridges. The flowers are placed on the ends of the branches, supported by a club-shaped footstalk. They are extremely small, and aggregated together in numbers of twelve or more in a head, surrounded by a showy involucre, three or four inches in length, and which is supposed by the non-scientific to be the flower. The flowers themselves are of a greenish yellow colour, but the four large obcordate leaves of the involucre are white, and sometimes tinged with violet. The outer extremity of each is notched as if from injury and this notch is purple or rose coloured. The calyx is extremely small. The petals and stamens are each four in number. There is one pistil with a filiform style nearly as long as the corolla. The fruit is a group of oblong, oval, shining, bright scarlet berries, crowned with the remnant of the calyx. They appear placed in the fork of two branches, which arises from the fact that while the flowers are terminal, yet ere the fruit is perfected, the two branchlets for the flowers of the succeeding year are developed and grow up on each side. These berries ripen here about July or August, and are eagerly devoured, despite their bitterness, by birds in the winter season. In Louisiana, the *C. florida* flowers in February, in our vicinity in April and May, and farther north in June and July. It is in bloom for a fortnight, during which time the Indian farmers say, Indian corn should be planted. The plant is of slow growth, and has a hard, heavy, solid wood, of a close texture, and susceptible of a high polish. It is often called Boxwood, and used as a substitute for it in the manufacture of handles of chisels, hammers, and such tools, for the cogs of wheels, teeth of harrows, spoons, &c. Soon after the fruit commences to ripen the leaves begin to change their colour, turning to a purple and then to a rich crimson or purple colour, and a bright russet beneath, forming one of the most beautiful objects of our forests during the fall months. It is figured in Botanical Magazine, t. 526.

Chemical analysis shows that the bark of the root, stem, and branches, which are bitter, astringent, and aromatic, contain in different proportions, the same substances as are found in *Cinchona*, except that there is more gum, mucilage, gallic acid, and extractive matter, and less resin, quinine and tannin. The principle obtained from it is called *Cornine*, and its salts have all the properties of these of quinine, though not so strongly marked. The principle is also difficult to obtain in any quantity. The extract of Dog-

wood, while inferior and less stringent than the best cinchona, is yet superior to the inferior kinds. This extract contains all the tonic properties, while the simple resin is merely a stimulant. Professor Barton says "that it may be asserted with entire safety that as yet there has not been discovered within the limits of the United States any vegetable so effectually to answer the purpose of Peruvian bark, in the management of intermittent fevers as the *Cornus florida*." It may be looked upon as our best native tonic. In some respects, however, it differs from quinine, as the powdered bark quickens the pulse, and sometimes produces violent pain in the bowels. On this account the preparations employed are the sulphate of cornine and the extract. Dr. O'Keefe of Augusta, Georgia, has prepared a valuable alcoholic and watery extract of the bark, which seems to possess all its medicinal properties. (See Trans. of Amer. Med. Association, vol. II., p. 671.) This may be used in intermittent and remittent fevers, also in typhus and all febrile disorders. In cases of debility, Dogwood is a valuable corroborant, for which purpose it may be combined with Colombo, Gentian, Chamomile, or Seneca root. Country people often use it as a decoction, or chew the twigs as a prophylactic against fevers. Drunkards sometimes employ a tincture of the berries to restore the tone of the stomach, and combat the pains of dyspepsia. Many have recommended a decoction of equal parts of Dogwood and Wild Cherry barks, as a remedy in dyspepsia, and the debility in convalescence from fever. The flowers have similar properties, and a warm infusion of them was often employed by the Indians in cases of chills and indigestion. They named the plant *Mon-hx-can-ni-min-schi.* The powdered bark of the plant makes one of the best tooth powders with which I am acquainted, as it preserves the gums hard and sound, and at the same time, renders the teeth extremely white. Rubbing the fresh twigs on the teeth has this effect, and the Creoles of the West Indies, the pearly whiteness of whose teeth is universally acknowledged, use another species in this way.

There are yet other uses to which Dogwood has been put. A sort of inferior ink may be made with the bark, using it instead of galls. A warm decoction of the bark with sassafras is a valuable wash for foul ulcers, and in veterinary medicine a decoction of the bark has been used with very good effect in a malignant disease called yellow water, Canada distemper, &c., very fatal among horses.

Thus I have endeavoured to place before you a sketch of one of the denizens of our Tennessee woods, and if my effort has at all interested you, it will give me pleasure to repeat it should you call on me on another occasion.

[Prof. Williamson, in remarking upon the above paper, stated to the meeting that he had not observed the *Cornus florida* in the immediate neighbourhood of Kingston, but he had seen it in the Niagara district.

Prof. Lawson exhibited specimens of the plant from various parts of the United States, and alluded to its wide range, but apparently southern tendency. It is no doubt correctly regarded as a Canadian species ; but it is absent from Prof. Barnston's list of the Holmes' herbarium, Montreal ; from Mr. Billings' list of Prescott plants, and other accessible local lists, as well as from the various collections made in the neighbourhood of Kingston. It is not difficult to trace the distribution of so showy a plant, and it is to be hoped that Prof. Blackie's remarks will lead to the publication of Canadian localities.]

ARTICLE II.—*A popular Treatise on the Fur-bearing Animals of the Mackenzie River District.* By BERNARD ROGAN ROSS, C. T.

[*Presented to the Natural History Society of Montreal.*]

In submitting the following Treatise to the notice of the Natural History Society of Montreal, I will, previously to entering on my subject, mark out the extent of country to which only, my remarks apply.

A residence of thirteen years in this District, during the greatest part of which time I have been a not unsuccessful trapper, has afforded me many opportunities of observation upon the nature and habits of the various fur-bearing animals inhabiting these high northern latitudes. I have throughout studied accuracy rather than effect, and the style of my remarks is doubtless rather popular than scientific ; yet the hope that my humble endeavours may perchance clear one doubtful point, or illustrate some new truth has lightened my labour, and will, if such should in reality happen, prove an ample recompense for my toil.

The boundaries of the Mackenzie River District may be considered to extend from Salt River, a tributary of the Slave to the Arctic Sea, and from 100° W. long. to the Rocky Mountains.

I cannot here omit mentioning the aid which I have received, in the scientific parts of the Treatise from the splendid, complete, and accurate work of Prof. Baird on North American Mammals. The general characteristics of Families are quoted verbation from his work.

Lynx, *Rafinesque.*

Gen. ch. Molars $\frac{3-3}{3-3}$ the small anterior premolar of Felis wanting. Tail considerably less than half the body, exclusive of the head and neck, generally not much longer than the head, and abruptly truncate at tip. Baird.

Lynx Canadensis, *Raf.*

Sp. ch. Size between that of a Fox and Wolf. Tail thickly furred, shorter than the head, and tipped with black. Paws densely covered with hair, and armed with strong claws. Color in winter, a silver grey on the back, paling towards the belly, which is sometimes white; a rufus undershade mixes with tints. The ears are pointed, not large, and tipped with a pencil of long black hairs. Whiskers generally white. Length from the tip of the nose to the tip of the tail about 3 feet. Average weight about 25 lbs.

This species is the largest of the North American Lynxes, and is the only one found in the Mackenzie River District. It is called by the "winterers" indifferently either Lynx Cat, Loup Cervier, or Pichen. In appearance it is rather formidable; its teeth are long and sharp, while its powerful claws and immense spring render it a dangerous opponent to any animal that it encounters. In its habits it is predatory. Hares and mice it devours with avidity; birds it pursues to the tops of the loftiest trees, and it even kills fish in their own element; while it has no objection to carrion, and, when pressed by hunger will even eat its own kind. Tales of the ferocity of this animal have been told by the early writers—of its attacking and mastering deer—but they are without foundation. It is a solitary beast, and I should consider its unaided strength perfectly incompetent for such a purpose.

In its motions, though very active, the Lynx is rather an ungainly animal. Its favourite pace is a succession of long leaps much in the manner of the American Hare (*Lepus Americanus*), which it also slightly resembles in shape. It is stupid, and easily caught. A sudden and loud cry from the hunter pursuing it is

sufficient to arrest its course for a time long enough to permit him to fire, and sometimes several shots are obtained at the same animal in this manner. It is easily killed, a not very heavy blow being sufficient to fracture its skull.

The colour of the fur varies much with the seasons. In winter the hair is thick, long, and silky. The grey markings are of a dark silver colour, while the rufus undershade is scarcely observable. In some specimens the dark stripe down the back would not disgrace a silver fox. In summer it wears a rusty look, the hair is short and thin; and there is more rufus and little of the silvery grey in the tints, while the skin is marked with black spots, which serve to distinguish a prime from a common fur, in trading with the Natives. These spots appear generally in April and disappear in November.

The Lynx is found all over this District, in greater or lesser numbers, wherever there are trees, even within the Arctic Circle. It is subject, like most of the other Fur Animals, to periodical migrations, which appear to occur with great regularity in periods of ten years, and which in its case depend on the Hare its principal food. One of the most curious of the idiosyncrasies of this animal is its passion for perfumes; and particularly for the odor of castoreum, which forms the basis of all the "medicines" used by trappers in effecting the capture of the Lynx.

There are four methods in which the death or capture of the Lynx is effected—by hunting—by the use of the steel-trap, or gin—by the simple snare—and by the medicated cabin: all of which I shall pass briefly in review:—

By hunting.—In this method the hunter pursues the animal generally aided by a dog, and follows its track in the snow, until he forces it to take refuge in a tree, when it is shot: yet so tenacious is the death grip of its powerful claws, that it is sometimes necessary for him to fell the tree, in order to obtain the body.

By the steel-trap.—The gin covered inside the jaws, with a well fitting "pallet" of birch bark, is placed indifferently either under or upon the snow, and on the pallet a piece of hair skin, well rubbed with the 'medicine' is tied. The Lynx on scenting his favourite perfume endeavours to withdraw the skin with his paw, and consequently springs the trap. It does not, like most of the other fur animals drag the trap to a distance, or make violent efforts to escape, it generally lies down until aroused by the ap-

proach of the hunter when it endeavours rather to spring at him than to take to flight.

By the simple snare.—A running noose of platted sinew, thread, or deer-hide thongs, is set in the track that the animal usually follows; this snare is attached to a pole of sufficient weight to toss up the body, and it remains hanging until the hunter passes. The body is sometimes found devoured by crows, wolverines, and Lynx.

By the medicated Cabin.—This is the most efficacious method of catching the Lynx. A round enclosure of some three feet in diameter is made of small willows, or branches of trees, loosely planted in the snow, and about four feet high. Two entrances are left at the opposite sides, each fitted with a snare. In the centre of the enclosure, the medicated skin is placed, inserted in a cleft stick, about eight inches distant from the snow. The snare is more commonly tied to the middle of a loose stick, about 30 inches long, by 3 in diameter, and which is supported on two pronged branches set on each side of the entrance, when circumstances are favorable the tossing pole is sometimes used, and it is the most certain fashion. The animal on scenting the castoreum, inserts its head, or sometimes its forefoot into the noose, which, owing to the long tips on the Lynx's ears, remains securely on the neck when once passed there. After enjoying and rolling itself in the perfume, it moves off; but on finding the stick thumping after its heels, it becomes alarmed and makes for the nearest woods; the stick soon catches in the bushes, and in a short time, the animal, instead of cutting the line, strangles itself, or if caught by the paw remains fixed until the hunter arrives to give it a "*coup de grâce*," if he does not find it already frozen stiff. On some occasions it will gain the top of a lofty tree, and on springing off to rid itself, as it fancies, of the stick, it hangs itself in a superior manner, and puts the trapper to the trouble of cutting down the tree, which is generally a large one.

As an article of food, the flesh of the Lynx, is highly esteemed both by the natives and the white residents. It is of a light colour, and well flavored, the fat, which is soft like that of the bear, lying mostly on the ribs.

CANIS (LUPUS) OCCIDENTALIS. VAR. GRISEUS (*Richardson*).

Grey or Strongwood Wolf.

*Var. White and Barren ground Wolf.**

Sp. ch. Size that of a large mastiff dog, but stands rather higher. Hair long and not coarse, under fur very thick and woolly. Tail very full but not so long in proportion as that of a fox. Colour varies. In barren grounds, variety generally white, in strong wood, dark grey, length from the tip of the nose to the tip of the tail about $6\frac{1}{2}$ feet, weight about 50 lbs.

This is the only species of Wolf in the Mackenzie River District but I am inclined to divide it into two varieties ; the dark grey, or the strong wood, and the white, or barren ground. These two are doubtless the same species, though in colouring, locality, and habits there is a considerable difference between them.

The general appearance of both varieties of wolf is rather prepossessing, resembling a good deal that of the native dogs. The head is full, broad between the ears, and tapering towards the snout. The legs, though rather long, are stout with good muscular development. The paws are large, furnished with strong claws, and well furred. The teeth are long and white ; and the jaws are of immense power. The eyes are placed obliquely, the inner corner tending downwards. The tail is moderately long and very bushy.

The white wolf is found inhabiting the barren grounds, and the wooded country bordering on them ; its migrations being dependent on the movements of the Rein-deer, its principal food. This kind of wolf lives in considerable bands, which unite in hunting parties to run down or surround the deer, driving them over cliffs, or into rivers or lakes as is most convenient. In size they are smaller than the grey variety, though much larger than the Prairie wolf. Their colour is generally a dirty yellowish white with most commonly a stripe of grey down the back ; but not always.

The dark grey, or strong-wood variety, which I have styled "Argentatus" from the resemblance of its color to that of the silver Fox, inhabits the wooded country. It most commonly is seen alone, but as many as 6 have been observed in a band. The only specimens of its skin which I have seen, were received at Fort Resolution on Great Slave Lake, and it is evidently still rarer

among wolves, than the silver is among Foxes. In its full winter pelage it is a magnificent animal. The color is a dark silver grey, with a rather browner tint than that of the silver Fox, under the belly a blueish black, the nose and paws black. The size of an old specimen is enormous, the skin being as large, when stretched and dried, as that of a barren ground reindeer.

The northern wolf is a very knowing animal, quite as much so as the fox; out of an immense number which I have heard, I will relate a few well authenticated anecdotes about it, most of which have fallen under my own observation. In the month of May, when the holes cut in the ice do not freeze up, the fisherman at Fort Resolution on visiting his trout lines, set at some distance from the fort, discovered that several had been visited, the lines and hooks were lying on the ice, as well as the remains of a partly eaten trout, and a wolf's track was observed about the place. The fact was that the wolf had hauled up the lines and helped himself to what fish he required. This occurred again and then ceased, the animal having been probably driven away by the dogs of the post. I have never heard of a wolf attacking man, though a dog has been carried off from the winter encampment now and then. When there is but a single wolf, one of our hauling dogs, which are a powerful cross between the pointer and native dog, will make a good fight and often beat off his opponent. The wolf, when taken young, is easily domesticated. It is affectionate and docile to its master, but snappish with strangers and rather quarrelsome with the dogs. A cross between a male wolf and a domestic bitch makes an excellent breed. The offspring are hardy, docile and strong, easily fed, and capable of enduring great fatigue. These hybrids will, contrary to the general rule, have young ones. When there are not too many dogs to drive him off, a male wolf will sometimes have connection with a bitch belonging to the fort, but I am doubtful if a female wolf would permit the attentions of a domestic dog. In the copulating season wolves become rabid, at which time their bite is generally fatal to dogs and other animals. Fearful of expatiating at too great a length upon the subject, I will conclude this anecdotary paragraph by a testimony to the sociability of the wolf, even in a wild state. A full grown wolf remained during the months of July and August 1857 quite domesticated at Fort Resolution. Though rather shy of the people, it lived in great harmony with the dogs, playing and sleeping with them, and sharing their food. Around

the smoke made to keep off the myriads of noxious flies from the cattle it reposed with the other animals, and, although there was a small calf in the band, it never attempted mischief. It was shot at by an Indian and never seen after. Wolves, when pressed by hunger, often come into the square of the fort, and one was shot once when endeavouring to affect an entrance into a meat store.

There are five methods by which wolves are captured or destroyed. By the pitfall; by the gin; by the trap; by the set gun; and by poison.

By the Pitfall.—This method is tolerably successful. A hole about 7 feet deep, broader at the bottom than at the top, is dug during the summer. It is covered with twigs and grass, and after the first fall of snow bears the same appearance as the surrounding ground. In the centre of the hole the bait is laid, and on approaching the animal falls into the pit, when he is easily killed.

By the Gin or Steel-trap.—The trap is set in the usual manner, covered with snow and baited; when caught the wolf struggles violently, and if the trap be not very strong will escape, after which he is very difficult to catch, as he will begin digging at some distance from the trap, which, when reached he will throw aside with his nose, and devour the bait at his leisure. Once securely caught, the wolf will take the bar of wood, to which the trap is fixed by an iron chain in his mouth, and trot off at a desperate pace seeking the worst country he can find. I was once obliged to follow a wolf two days in this manner, and only secured him in the end by the aid of dogs.

By the Wooden Trap.—A large trap of strong pieces of wood is made. First stakes are driven into the earth enclosing a circular space, with two convenient saplings for door-posts, a log of wood, or sleeper, is laid across the door, at the foot of these, with another longer and lighter piece on the top for the purpose of being lifted up when set. The roof of the trap is then covered with small sticks and brush, some logs of wood are laid as weights on the upper piece lying across the door, and a strong stake is driven into the ground to prevent the animal, when caught, from hauling the top piece off the sleeper. The trap is then prepared for setting, to effect this some of the weights are thrown off, and one end of the top piece lifted sufficiently high to permit a stick about a foot long to be inserted upon the

butt of the bait stick which is about 18 inches long with a piece of fish or meat fixed on the point, and is placed inside the trap. The weights are then replaced and some pine brush thrown loosely on the top. This fashion of catching wolves is not very successful, except in the fall and beginning of winter.

By the Set-gun.—This is a very sure method though rather dangerous to the hunter, if he do not take great care. The gun is tied upon two saplings or stakes, set on purpose, opposite the trigger is another thinner stick firmly planted on the ground, a piece of wood is laid across this stick one end pressing the trigger, the other attached to a line to the other extremity of which the bait is affixed. This line is carried under the snow by boring holes in pieces of board and passing it through them; this also prevents the animal from pulling the bait out of the aim of the gun, which he discharges as soon as he hauls upon the line to obtain the meat. Instances have been known of wolves cutting the line close to the trigger of the gun, after which they eat the bait in safety.

By Poison.—In this case strychnine is used, which is an infallible method, though the animals sometimes go to such a distance that it is difficult to follow their tracks; and if a fall of snow come after they have eaten the bait their bodies are often lost. About two grains are required to kill a wolf quickly. But as this article is already too long, I will defer the detailed account of the effect of strychnia on wild animals, until I write the article upon Foxes.

Canis familiaris. *Linn.*

Var. *Borealis*, or Esquimaux Dog.

et Lagopus, or Hare Indian Dog.

Sp. ch. (of both). Size, about that of a pointer; ears small and pointed; head broad between ears, and tapering towards muzzle; colour varied, but whites and greys predominate; hair long and fine mixed, with thick under fur; tail long and bushy; general appearance that of a wolf.

In comprising the Hare Indian and Esquimaux dogs among the fur-bearing animals of this district, I am perfectly aware that, in a commercial point of view, they are not included among them; still, from their wild nature, as well as their long and thick fur, I consider that I may with strict propriety class them in the branch

of natural history upon which these notices treat. I should also wish to point out a few errors into which previous writers on these animals have fallen, as well as to submit to the philosophical world some of the results of my experiments and investigations in this branch of animated natnre.

The Esquimaux dog *var. Borealis* is found, as its name implies among the Huskey tribes of the Arctic coast. It is of considerable size, muscular and well-proportioned. The ears are small and pointed, and with a good breadth of skull between them, the muzzle is long and sharp, the eyes are placed at angles, not horizontally, the fur is deep and thick, the tail bushy, the feet broad and well covered, and the colour is generally pure white, though other shades are not uncommon.

It is said, with what correctness I cannot venture to say, that the voice of the Esquimaux dog in its native wilds is not a bark but a long melancholy howl. I have had several in my possession all of which barked lustily, but they may have learnt this accomplishment from the dogs of the fort. The similarity of appearance between this dog and the barren ground wolf is very great. It is a hardy animal capable of enduring great extremes of cold and hunger, but in the latter case it becomes very ferocious and instances have occurred of children being devoured by it.

There is no want of sagacity in the Esquimaux dog, its whole look tells of its wisdom and cunning. It is very sociable and fond of its master. When two of this breed of dogs begin fighting, the whole band light on one of the pair and if not prevented will tear him in pieces.

The Hare Indian dog, *var. Lagopus*, is the race domesticated among the Indians of the Mackenzie River District. It is characterised by a narrow, elongated and pointed muzzle, by erect sharp ears, and by a bushy tail not carried erect but only slightly curved upwards, as well as by a fine silky hair mixed with thick under fur. Its colour is tolerably varied in the shades of brown, grey, black, and white. Of these tints the darkest are the most rare. A white or greyish white being the most usual shade. Some writers have supposed this animal to be a domesticated white fox but the thing is highly improbable. The Indian dog, though there are great differences in its size, has on an average more than treble the proportions of this species of fox, moreover it will not have connection with this or any other branch of the sub-

family *Vulpinœ*, while its varied shades of colour are never seen in the pure white pelt of the arctic fox; with wolves on the contrary, not only will they cohabit but will also produce a hybrid offspring that will for several generations procreate one with another. This fact manifests the close connection that both these varieties of dogs have to the wolves, and would almost prove them identical. Thus far I admit, but I do not, for reasons which I shall afterwards give, consider them only domesticated wolves. They are in my opinion, specimens rather of the parent canine stock unaltered by human experiments, and in appearance such as Adam might have named in the garden of Eden.

With foxes of any description neither these nor any other dogs will copulate. At Fort Resolution I had a very fine pair of cross foxes in confinement. They were kept within a roomy enclosure surmounted with lofty stockades. One of the windows of my dwelling-house commanded this enclosure, and at it I used to spend hours observing their actions and movements. When the bitch fox went in heat in the spring she had connection with her mate. And wishing to decide upon the extent of the affinity existing between the fox and the dog, I shut up a small terrier with her. There was no courtship, the parties were mutually indifferent. I tried Indian, half Indian, and our own hauling dogs, but with no success, they evidently would not enter into a matrimonial speculation, though they were friendly enough. This experiment may perhaps be allowed to decide the case in point.

Wild dogs are known to exist in many countries. The Ajuara of S. America, the Dhol of India, and the Dingo of Australia, for instance, all bear a close resemblance to each other, and to the Arctic American dogs, in the most essential particulars. Therefore, seeing that wild dogs as distinct from wolves exist, it is to some such animal that I am inclined to attribute the origin of the dog. From the earliest ages the dog and wolf have been distinguished from each other, and the varieties to which this article is devoted, may have derived their certainly very wolfish appearance from crosses in the breed.

Whatever be the origin of these animals they are of the greatest service, in fact a necessity to the aboriginal dwellers in these dreary and barbarous wilds. They are the only beasts of burthen, and although they have not the strength of the fort dogs, still a train or team of three good ones, will haul a load of upwards of three hundred pounds, five hundred being considered a

good load for the others. Their life is a hard one, far worse than that of a tinker's jackass, a blow or a kick is the usual caress bestowed upon them by their master. Their food is mostly the excrement and offal of the camp, hare-skins and paws, and any other trash too wretched for the far from nice stomach of a Chippewayan Indian. I have seldom or ever seen a fat dog among the natives. They make very good hounds to follow deer or moose on the crust of the snow in spring; for though they have not sufficient strength to bring down these animals themselves, they retard their progress sufficiently to allow the approach of the hunter. I have seen some tolerable retrievers among them also.

I will now conclude this article by offering a just tribute to the affectionate disposition, and kindly habits of this poor and ill-used "friend of man." Scanty fare, harsh treatment and want, seem to make little difference in his love, and these miserable starvelings shew as much if not more affection for their hard-hearted and tyrannical master, than do the pampered and petted favourites of European old maidenhood.

Sub-Family.—VULPINÆ.

Gen. ch. Pupil of the eye elliptical; head slender; upper incisors scarcely lobed; post-orbital process of the frontal bone bent but little downwards, the anterior edge turned up; a longitudinal shallow pit or indentation at its base.

VULPES FULVUS.—*Common American Fox.* (*Desm*).
Var. A. *Fulvus*, Red Fox.
" B. *Decussatus*, Cross Fox.
" C. *Argentatus*, Silver Fox.

Sp. ch. Hair long, silky and soft. Tail very full, composed of an under fur with long hairs distributed uniformly along it. Distance in red variety between hairs, 6½ inches. Tail with white tip, feet and ears black.

Var. Fulvus. Reddish-yellow; back behind grizzled with greyish. Throat and narrow line on the belly white. Ears behind and tips of caudal hairs (except terminal brush) black.

Var. Decussatus. Muzzle and under parts with legs black, Tail blacker than in the other variety. A dark band between the shoulder, crossed by another over the shoulder.

Var. Argentatus. Entirely black except on the posterior part

of the back, where the hairs are annulated with grey, this occasionally wanting. Tail tipped with white. Baird.

In treating on the different varieties of foxes I have spoken of, it is extremely difficult to mark the line where one ends and the other commences. During my residence in these regions I have seen every shade of colour among them, from a bright flame tint to a perfectly black pelt, always excepting the tip of the tail, which in all cases is white. Even the judgment of an experienced fur trader is sometimes at fault to decide, in bartering, to which of the three varieties a skin should belong, as they bear different prices. Still, notwithstanding this, I consider these colours to have been produced by intermixture of breed. The different varieties, being in my opinion, quite as distinct as those of the human race. And I do not think that any of the progeny of two pairs of red foxes would be either black or cross. In cohabiting the male foxes accompany the females in bands of from 3 to 10, much in the manner of domestic dogs. At Durwegan on Peace River, I have repeatedly observed this. The males fight violently for the possession of the females, many are maimed and some killed. A number of males thus in all likelihood cohabit with the same female, which gives rise to the varieties of colour in a litter. Instances are reported as having occurred in which all the varieties were taken in one den, but of this I am rather doubtful. It is very difficult to tell the future colour of cub foxes, the red appear to be cross, and the cross to be silver, which may have caused an error, though I write under correction. I have seen many Indians even mistaken in this. They have brought me live cub foxes for silver, which on growing up proved to be cross. My own theory is that the silver fox is the offspring of two silver parents, the cross, of a silver and red, the red, of two reds, and the different shades being caused by fresh inter-breeds. Thus two negroes will have neither white nor mulatto children, nor will two whites have black or mulatto offspring. I do not know whether I have explained my ideas on the subject clearly or not. They are the result of my experience on a subject to which I have given no small attention. I have often robbed fox dens, and have also bred the animals, and the summing up of this part of my subject may be thus made—like colours reproduce like, black and red being origins, the cross is the fruit of intermixture between these shades. I kept a pair of cross foxes in confinement at Slave Lake, their offspring were *all cross*. I had only one litter when the bitch died.

Foxes are very shy animals and difficult to tame, indeed when old they appear to pine away in confinement, when young they are playful, but at all times rather snappish. They are far from sociable and generally burrow alone, although it is not uncommon for the members of one family to live together.

The fox-burrow or den is often many yards in length, with various ramifications and side galleries to it, in the centre of which an excavation rather wider than the passages, serves for the sleeping apartment. To this there are always two entrances and often more. The den is kept very clean, and in some dozen which I have opened, I found neither bones of animals nor offal of any kind. To dig out a fox a flat piece of iron, called an earth-chisel, is tied to a stout wooden handle, the trapper inserts a long slender pole of willow, or other flexible wood into the entrance, having stopped up any other that exists, to find the direction in which the passage runs. He then digs another hole and inserts his pole, finding with its point whether any other passage exists, and if so, marking the direction. In this manner he proceeds till he digs to where the fox is, who is generally killed in one of the side galleries, or close to one of the closed entrances. This method of killing a fox entails a large amount of labour, as it often takes a whole day to unearth the animal.

Of all the natural gifts of the fox, the most remarkable is his exquisite sense of smell. When the fox finds a piece of meat or fish he almost invariably hides it, and returns to eat it at some future period. I have remarked this trait even in cubs, which I have reared in confinement, and which used, previous to eating, to dig holes in the snow to bury their food, pushing the snow with their noses to cover it. During the commencement of summer he will lay up a store of the eggs of wild-fowl, for his winter's consumption, these he deposits in holes dug in the sand bars of the river, or in beds of moss, and at the expiration of several months, will, when pressed by want, visit his *caches*. Even when there are several feet of snow on his deposit, he will readily distinguish the place by scenting his urine, with which a fox invariably sprinkles in a liberal manner, all his secret hoards.

This animal is by no means choice in his food; mice, birds, hares, fish, carrion, all come alike to him, and he will even make a meal of a fellow fox if he find one dead in a trap. In summer a great number of young water-fowl are killed by him, and when musk-rats are, by the freezing up of their houses, driven to migrate in the winter, he devours them without mercy.

Respecting any special difference between the three varieties, I can see but very little. The cross fox is generally the largest, and the silver fox the most thickly furred. Some trappers profess to know by the shape of the foot, whether a specimen be that of a silver fox or not; their idea being that the foot of that variety is more rounded than the others. But I have often seen them mistaken. The foot-prints of a young fox of whatever colour, have always this appearance, and the foot of the female is more pointed than that of the male. A popular fallacy also prevails among the "winterers," that a silver fox is more cunning than one of any other colour. I imagine the scarcity of the silver variety originated this fancy.

The foxes of this district are generally of a very large size, and I am doubtful if they do not belong rather to the Macrourus than the Fulvus species. A series of measurements which I will hereafter get taken will decide the question.

The foxes inhabiting the barren grounds often present an appearance similar to that of the Sampson fox, the long hairs of the body and tail are wanting, leaving the soft woolly fur entirely exposed in some specimens, and in others partly so, particularly the sides of the thighs. The natives attribute this to their living so much in their holes, which are generally among rocks, and not roaming about so frequently as those inhabiting the wooded country which often do not visit their dens for weeks together.

The following table shows the proportion of each color traded in this district during the last ten years, and will give a very accurate idea of the relative number of each variety.

Red $\frac{6}{15}$ Cross $\frac{7}{15}$ Silver $\frac{2}{15}$.

Foxes are most prevalent around the great lakes, and on the shores of the Arctic sea. On the Mackenzie River they are also tolerably numerous, but towards the Mountains up the Liard's River they become very scarce.

There are several methods by which foxes are caught and killed, which I will pass in review, detailing those which differ from any already described. 1. By wooden traps; 2. by gin or steel traps; 3. by set guns; 4. by snaring; 5. by hook and line; 6. by hunting; 7. by unearthing; 8. by ice-trap, and 9. by poisoning.

Nos. 1, 2, 3 and 7, have been already noticed, I shall therefore commence with

No. 4, *By snaring.* This is not a very efficacious method,

and is used only by natives who have not steel traps or gins. An enclosure of twigs is made and the bait laid in the centre and a snare set in the entrance with a road fenced in like manner leading to it. The principle of construction is the same as in lynx-snaring, and alike in every respect excepting that the enclosure is larger. Foxes are sometimes found hung in snares set for rabbits.

5. *By hook and line.* This cannot be exactly considered a legitimate method of entrapping foxes, though I have seen one killed by it. An Indian at our establishment was visiting and arranging his lines for catching Loche (*Gadus lota*), when he observed a fox at a short distance from him regarding his operations; he immediately flung the baited hook towards it, and concealed himself behind a block of ice. Reynard approached, smelt rather suspiciously at the bait and at length swallowed it, whereupon the Indian without giving the animal time to cut the line, hauled in and killed it.

6. *By hunting.* This method is practised in the fall before there is enough snow to set the traps. The hunter conceals himself close to the fox's hole, and shoots him as he passes to it.

8. *By ice-traps.* This is a tolerably successful way, more so than by wooden traps. A block of ice of considerable weight is tilted on end at an angle of about 45°, a piece of stick supports this, placed well under the block, the lower end resting on the bait. The animal in his efforts to obtain the bait drags the stick off the perpendicular when the ice falls on him and kills him. This method is much used by the Yellow Knives to trap white foxes.

9. *By poison.* For this purpose strychnia is used. I have tried aconitine, atropine, and corrosive sublimate without success. The two former may not have been pure enough, though I obtained them from the first chemical works in England and at a very high price. The only poison that I have found strong is strychnia. One or two grains of this are mixed with a little tallow, forming a small ball, and covered with a coating of grease outside to prevent the animal from tasting it. A quantity of pounded dried meat and morsels are strewn about so that the animal after swallowing the poison may be detained a sufficient time for it to operate. The distances which animals go before they die vary greatly; in some instances they fall directly, in others they run several miles with the same dose, and arranged in like

manner. This I attribute to several causes; to their fatness, and to the quantity of food in their stomachs, as lean and hungry foxes die much more quickly than others. The medium in which the poison is given also causes a great difference. When put up in fresh meat a very long time elapses before it operates.

Wishing to preserve a specimen of the Hare-Indian dog for the Smithsonian Institution, I resolved to kill the animal by poisoning. Two grains of strychnia of the first strength were administered in a piece of fresh meat, at the end of two hours the animal was as well as ever. I then administered one grain more mixed with grease, in two minutes the spasms began, and in five the animal was dead. The first symptoms were a restlessness and contraction of the pupil of the eye, and a flow of saliva from the mouth, violent cramps then ensued, the head shook violently, like a paralytic person, the legs were drawn up, and the spine took a circular shape, a lull of a few seconds then ensued, when after an attack of great violence the animal died. On dissection the blood vessels of the head and neck were found very full of black and clotted blood, such as I have seen in the jugular vein of a person who had died of apoplexy. There was no inflammation of the stomach, and the fatal bait was found in the throat entire. Once seen, the symptoms of poisoning by strychnia are easily recognized, and I would be certain now of passing a correct opinion on a case of the kind.

Dogs take a longer time to expire than either wolves or foxes; the latter dying most quickly; in fact according to the ratio of the wild nature of the animal who eats it will be the quickness and violence of its death.

Vulpes Lagopus.—Arctic Fox.

Var. A. *Lagopus*—White Fox.

Sp. Ch. Smaller than American Red Fox; tail very full and bushy, soles of feet densely furred, tip of nose black.

Var. B. *Borealis.*—Blue Fox.

Sp. Ch. Similar to the white in every particular except that of color.

Lagopus—White Fox.

This diminutive Fox which is about as large as a small terrier inhabits the barren grounds and sea coast of this district. On only two occasions have I known it to be caught on the South

side of Slave Lake, once at Resolution and once at Big Island. Its fur is thick, about 2 inches long, white in color with the under fur a lead tint. In winter the animal is white all over excepting the tip of the nose which is black, a light shade of lead is, however visible on the shanks and feet. These are densely furred and the nails are brown. In summer the fur is about an inch in length, white beneath the belly, but owing to the falling off of the long hairs a stripe of plumbous grey annulated with white, and about three inches broad extends from the nape of the neck to the tail, widening towards the rump and passing over the tops of the thighs. The whiskers white in winter, have brown hairs intermixed, and a yellowish tint surrounds the ears, eyes, and mouth, and tinges the shanks and feet. A few long dark hairs may be perceived by careful examination, sprinkled down the back, and the tail has a slight plumbous shade mixed with faint yellow. The color does not approximate in either summer or winter pelage to that of the blue Fox which has been erroneously stated to be the young of the white. The white fox measures in a good specimen which I have before me 22 inches from the tip of the nose to the root of the tail, which measures 13 inches to the end of the hairs. It is an extremely stupid animal, easily killed and very tame. It is sometimes knocked on the head in open day while following the sleds of the Indians. It lives on mice, carrion, birds, especially Ptarmigan, to which it is a deadly enemy.

Borealis.—Blue Fox.

In the lack of positive information upon the subject I am uncertain whether to consider this as a mere variety of the white fox, or to class it as a distinct species, but I will,for the present, consider it as the former.

The Arctic Blue Fox measures 35 inches from the tip of the nose to the root of the tail, which is 13 inches in length to the end of the hairs. Its color in winter is a plumbous brown; the under fur plumbous, and the larger hairs brown at the tips, with white hairs interspersed but not in great numbers. On the head and nape of the neck the color is a reddish grey, like the tint of a silver fox in summer pelage. Under the throat down to the chest, the color is nearly a pure chocolate paling on the belly into a shade similar to that of the back, the sides and flanks are nearly pure plumbous, mingled with white hairs. The legs are brownish grey, and the fur, which covers the soles of the feet

densely, is a dirty white. The claws are nearly an inch long, brown in color, strong, and well curved. The tail is of a like tint with the back, but of a lighter shade. The nose is reddish with a black tip. The fur is remarkably thick and fine, and the tail very full. In summer pelage it is difficult to define the color, but it may be called a smoky brown, on the forehead the grey of the winter coat still remains, and there is also a faint stripe of the same shade down the centre of the back. There is less of the reddish tint throughout than in the winter fur.

It has been supposed that the blue fox is the young of the white fox but this I do not think possible. The specimen now before me is full grown, and in fact it would be a very large animal of the other color. The color is also very rare, for while hundreds of white are traded, not more than six, on an average, of the blue are exported yearly from this District. If they were the young of the white the number would be certainly greater. What are traded are all obtained from the Eskimos inhabiting the sea coast, so that it may justly be termed a littoral animal. On only two occasions, to my knowledge, has it been killed inland, and then at the eastern end of Slave Lake close to, or on the barren grounds. But on inspecting the two animals minutely, so close is their resemblance to one another, except in color, that I am inclined, in default of more precise information, to class them as varieties of the same species, the blue being a rare one and holding the same position that the silver does in the Fulvus species. An examination of a number of skins would doubtless show shades of color filling up the intermediate position that the cross fox holds to the other group.

FAMILY.—*Mustelidæ.*

Fam. Ch. Carnivora with a single tubercular molar tooth only, on either side of the jaw; the sectorial premolar of typical shape; feet five toed: plantipode, or digitipode. Coccum wanting.

The preceding diagnosis, taken from Wagner, expresses in a few words the characters of a group of the carnivora, of which there are several representatives in this District.

In this family are contained three sub-families Martinæ, Lutrinæ and Melinæ. These include several genera, comprising species of some of the most valuable and beautiful fur animals of North America. Of the Mephites, I found the bones, and a portion of the skin of a common skunk, (*Mephitis mephitica*) lying partially

decayed in the woods, at a short distance from Fort Resolution on the shores of Great Slave Lake. But as I have never seen the animal alive there, and the natives report that it does not frequent the county within a considerable distance of that post, this sub-family must be considered as unrepresented in the fauna of Mackenzie's River.

The food of the Mustelidæ is animal. Birds, reptiles, eggs, and especially mice, are eaten by the martins; the otter, and mink eat fish; but the wolverine delights in carrion. This last is a most destructive beast, but an account of its propensities will be given when I come to review the subject in detail.

Although these animals are so fierce and blood thirsty when in their natural state, they are far from difficult to tame, and I have seen martins, ermines, minks and otters, in confinment which appeared affectionate and graceful pets; and there is no reason why the wolverine, fisher, and skunk, should not become equally docile, though I doubt if any person would much like the latter animal about the house.

Sub-Family.—*Martinæ.*

Upper true molar short, transversely elongated, molars unequal in the two jaws. Soles generally hairy, the walk more or less plantigrade. In this sub-family are included several animals inhabiting the colder regions of North America, and whose fur is among the most valuable produced on this continent. It contains 3 genera:

1. Mustela. 2. Putorius. 3. Gulo.

All of which have representatives in this District.

1. Mustela.—Lin.

Teeth 38. Molars one above, and two below, premolars four on each side above and below. Lower sectorial tooth with a small internal tubercle. Body slender: tail rather long.

This Genus embraces the martins in distinction to the weasels. Its species are usually of large size, arboreal habits, and all of them yielding peltries of great value. Two and possibly three species inhabit this district, the largest of which is *M. Pennanti*, another is *M. Americanus*, or American pine martin; and the sable, *M. Zebellina*, will probably be found in the Northern and N. W. regions to constitute a third.

MUSTELA PENNANTI.—*Erxleben.*

Sp. Ch. Legs, tail, belly and hinder part of back, black, the back with an increasing proportion of greyish white to the head. Length over two feet. Vertebræ of tail exceeding twelve inches.

This animal is the Pecan or Fisher of the fur traders. In this district it is not found except in the vicinity of Fort Resolution, which may be considered as its northern limit. In the numerous deltas of the mouth of Slave River it is abundant, frequenting the large grassy marshes or prairies, for the purpose of catching mice, its principal food. In appearance it bears a strong family likeness to both the martin and the wolverine. Its general shape assimilates more to the former, but the head and ears have a greater similitude to those of the latter. It is named by the Chippewayan Indians "Thâ chô," or great martin. Its neck, legs and feet are stouter in proportion than those of the martin, and its claws much stronger. In color and size it varies greatly. Young full-furred specimens, or those born the previous spring, can scarcely be distinguished from large martins except by a darker pelage and a less full, and more pointed tail. As it advances towards old age, the color of the fur grows lighter, the long hairs become coarser and the greyish markings are of greater extent and more conspicuous.

The largest fisher which I have seen, was killed by myself on the Rivière de Argent, one of the channels of the mouth of the Slave River, about 15 miles from Fort Resolution. It was fully as long as a Fulvus fox, much more muscular and weighed 18 lbs. In the color of its fur the greyish tints preponderated, extending from half way down the back to the nose. The fur was comparatively coarse; though thick and full. The tail was long and pointed, and the whole shade of the pelage was very light and had rather a faded look. Its claws were very strong and of brown color; and as if to mark its extreme old age the teeth were a good deal worn and very much decayed. I caught it with difficulty. For about two weeks it had been infesting my martin road, tearing down the traps and devouring the baits. So, resolved to destroy it, I made a strong wooden trap. It climbed up this, entered from above, and ate the meat. A gun was next set but with no better success, it cut the line and ran off with the bone that was tied to the end of it. As a "*dernier resort*" I put a steel trap in the middle of the road, covered it

carefully, and set a bait at some distance on each side. Into this it tumbled. From the size of its foot-prints my impression all along was that it was a small wolverine that was annoying me, and I was surprised to find it to be a fisher. It shewed good fight, hissed at me much like an enraged cat, biting at the iron trap, and snapping at my legs. A blow on the nose turned it over when I completed its death by compressing the heart with my foot until it ceased to beat. The skin when stretched for drying was fully as large as a middle sized otter, and very strong, in this respect resembling that of a wolverine.

In their habits the fishers resemble the martins. Their food is much the same, but they do not seem to keep so generally in the woods. They are not so nocturnal in their wanderings as the foxes. An old fisher is nearly as great an infliction to a martin trapper as a wolverine. It is an exceedingly powerful animal for its size, and will tear down the wooden traps with ease. Its regularity in visiting them is exemplary. In one quality it is however superior to the wolverine, which is that it leaves the sticks of the traps lying where they where planted; while the other beast if it can discover nothing better to hide, will câche them some distance off. It prefers flesh meat to fish, is not very cunning, and is caught without difficulty in the steel-trap. Fishers are caught by methods similar to those employed in fox-trapping.

Mustela Americana.—*Turton.*

Pine, or American Martin.

Sp. ch. Legs and tail blackish, general color a deep and rich orange brown clouded with black along the back. Head generally light coloured, with the tips of the ears and a stripe along the cheeks yellowish white. A broad orange patch is visible on the throat in some, in others this is neariy pure white, and in many entirely wanting. Sometimes, but rarely, the tip of the tail is white. Tail vertebræ about a third of the length of the body, often longer, outstretched hind feet reach nearly to the end of the tail with the hairs.

The *M. Americana*, as found in this District, is smaller than the fisher, but larger than the ermine weasels. In its shape it is less muscular, but more graceful than the former of these animals. Its head is somewhat depressed, acute, and broader than might be looked for in so lengthened a skull. The ears are slightly pointed

and covered densely on both sides with a short velvety fur, overlaid with coarser hairs. The legs are robust, rather short, and clad with a closer and stiffer hair than that on the body. The claws are about half an inch long, not very stout but sharp, well curved, and white in color. The tail is considerably less than half the length of the body generally, though it is sometimes longer; it is well covered and tolerably bushy. The feet are comparatively large, densely covered with short woolly fur, mingled with stiffer hairs, which prevents the naked balls of the toes from being visible in winter, though they are distinctly so when the animal is in summer pelage.

The winter fur of this species is full and soft, about an inch and a half deep with a number of coarse black hairs interspersed. The tail is densely covered with two kinds of hair, similar to those of the back but coarser. The hairs on the top are longest, measuring $2\frac{1}{2}$ inches and giving the end a very bushy appearance. The fur is in full coat from about the end of October until the beginning of May, according to locality. When in such a condition the cuticle is white, clean, and very thin. From the latter of these dates the skin acquires a darker hue which increases until the hair is renewed, and then gradually lightens until the approach of winter, the fur remaining good for some time before and after these changes. When casting its hair the animal has far from a pleasing appearance, as the under fur falls off leaving a shabby covering of the long coarser hairs, which have then assumed a rusty tint. The tail changes later than any other part, and is still bushy in some miserable looking summer specimens now lying before me. After the fall of these long hairs, and towards the end of summer a fine and short fur pushes up. When in this state the pelage is very pretty and bears a strong resemblance to a dark mink in its winter coat. It gradually lengthens and thickens as winter approaches, and may be considered prime after the first fall of snow.

It is difficult to describe the color of the martin fur accurately. In a large heap of skins (upwards of fifty) which I have just examined minutely, there exists a great variety of shades darkening from the rarer of yellowish-white and bright orange, into various shades, of orange-brown some of which are very dark. However, the general tint may with propriety be termed an orange brown, considerably clouded with black on the back and belly, and exhibiting on the flanks and throat more of the orange tint.

The legs and paws as well as the top of the tail are nearly pure black. The claws are white and sharp. The ears are invariably edged with a yellowish white, and the cheeks are generally of the same hue. The forehead is of a light brownish grey, darkening towards the nose, but in some specimens it is nearly as dark as the body. The yellowish marking under the throat, (considered as a specific distinction of the pine martins) is in some well defined, and of an orange tint, while in others it is almost perfectly white. It also varies much in extent reaching to the fore-legs on some occasions. At other times it consists merely of a few spots, while in a third of the specimens under consideration it is *entirely wanting.*

After minutely comparing these skins with Professor Baird's and Dr. Brandt's description of the martins, and the latter gentleman's paper on the sables, I find that the *M. Americana* of this district agrees in general more closely with the latter, and am therefore disposed to coincide with that gentleman in his opinion that they are only varieties. The martins of this district bear a greater resemblance to the sables of Eastern Siberia than to the martins of Europe, holding, as it may be with propriety said, an intermediate position. I am also inclined to believe that the various colors found in these regions are simply varieties of the same species, and that the difference, if any, seen in the Zib. are merely continental. In summer when the long hairs have fallen off, the pelage of this animal is darker than in winter. The forehead changes greatly, becoming as deeply colored as any other part of the body, which is of an exceedingly dark brown tint on the back, belly, and legs. The yellow throat-markings are much more distinct at this season, but vary much both in color and extent, though in only one summer skin are they absolutely wanting. The white edging on and around the ears still remains, but the cheeks assume a greyer tint. The tail is not so full, but from the high North latitude (the Arctic coast) from which these skins were procured it is still rather bushy. One of the specimens has the dark hairs laid on in thin longitudinal stripes, causing a curious appearance.

Martins are found all over this district, except on the barren ground to which, as they are arboreal animals, they do not resort. Their dens are sometimes excavated, but more frequently are made in a tree. Their principal food is mice, and they are therefore abundant whenever these little creatures are plentiful.

The periodical disappearance of this species is very remarkable It occurs in decades, or thereabouts, with wonderful regularity and it is quite unknown what becomes of them. They are not found dead. The failure extends throughout the Hudson Bay Territory at the same time. And there is no tract, or region to which they can migrate where we have not posts, or into which our hunters have not penetrated.

They are caught commonly in wooden traps baited with white-fish heads, pieces of flesh meat, or still better with the heads of wild-fowl, which the natives gather for this purpose, in the Autumn. When they are at their lowest ebb in point of numbers, they will scarcely bite at all. Providence appears thus to have implanted some instinct in them by which the total destruction of their race is prevented. Martins are easily tamed, and look exceedingly pretty as pets. When enraged they utter a sound somewhat like the hissing of a domestic cat.

Putorius, *Cuvier.*

"Teeth 34: molars one above and two below: pre-molars three above and three below, on each side. Lower sectorial tooth without an inner tubercle. Body slender; tail unusually long.

The most striking difference between this genus and the genus *Mustela* consists in having one molar less on each side above and below. The size is generally smaller, and the body more slender in the typical species.

The genus includes many North American groups, which may almost be considered as generic, or at least of sub-generic value. They may be characterized as follows :—

Putorius. Body stout, darker below than on the sides. Of this particular group America has no immediate representative.

Gall. Body elongated and very slender. Lighter above than below on the sides. Naked pads on the feel small, more or less hidden by the hair. To this group belong all the American weasels, except the minks, unless the *P. negripes* of Aud. and Bach., should prove an additional exception.

Lutreola. Color nearly uniform all over. Feet much webbed. The naked pads on the feet large, not covered up by the hairy soles; the intervals between the metacarpal and metatarsal pads not occupied by hairs. Posterior upper molar longer than in Gale." Baird.

Of the above the only species which can be included among our fur-bearing animals is:

PUTORIUS VISON, *or common Mink.*

Sp. ch. Tail about half as long as the body. The winter color varies, according to the age of the specimen, from a very dark blackish brown, to a deep chesnut. Tail not bushy and very black. End of chin white. Length of head and body about 20 inches. Length of tail with hairs about 10 inches.

In shape the mink resembles an otter, as it also does in the color and quality of its fur. In size it generally has about the same dimension as the *M. Americana.* The color of its pelt varies greatly. In winter its shades range from a dark chesnut to a rich brownish black. The tint of all the body is uniform, except that the belly is sensibly lighter, and that there is a series of white blotches, running with greater or smaller breaks from the end of the chin to some distance below the forelegs, and again continued with more regularity from the middle of the belly to the anus. In some skins these markings are of small extent, but I have never seen them entirely wanting. There are commonly spots under either one or both of the forelegs, but not invariably. I have remarked that the coloration of this animal as well as that of the Otter and Beaver grows lighter as it advances in years, and that the white blotches or spots are of greater size and more distinctness in the old than in the young. The fur of a young mink (under three years) when killed in season is very handsome, its color is often an almost pure black. The skin is thin and pliable, approaching nearly to the papery consistency of that of the martin. When aged the hide is thick and the color more rusty. The summer pelage is short, but tolerably close, and is of a reddish brown color, and the tail though still possessing black hairs, shews distinctly the under fur of a decidedly rusty hue. Its feet are rather pointed, and not large. Its legs are short but muscular, and its track in the snow is easily distinguished from that of the martin, whose longer and well covered paws do not sink so deeply. Indeed when the snow is at all deep and soft, the mink makes a regular furrow, similar to that made by an otter under like circumstances, though of course smaller. Its claws are white and about ½ of an inch long. The mink is easily tamed and is exceedingly graceful in its movements. When it locates near

a settlement, such as Red River, it is a dreadful destroyer of domestic poultry. In the wilderness it exercises this propensity on birds and water-fowl. It is almost omnivorous, being equally fond of fish and flesh.

The various methods of trapping this animal have been already detailed, and are similar to those employed in the capture of the martin. It is not difficult to catch in steel traps, though rather shy of wooden ones.

I am strongly inclined to the opinion that there is only one species of mink on this continent, and consider it highly probable that the *P. Nigrescentes* of Aud. & Bach are merely common minks under 3 years of age. I have seen numbers of skins here of exactly the same color, size, and furring as those described under that head in Prof. Baird's work on North American Mammals, which were simply young *P. visones.* This gentleman also states that the American species of mink never has the edge of the upper lip white. I have never seen *the whole* of that part so coloured, but in one specimen now on my table there is a white spot beneath the nostrils.

Gulo : *Storr.*

"Teeth 38, molars 5 above and 6 below. Lower sectorial teeth without any internal tubercle. Soles densely hairy with 6 small naked pads. Tail about as long as the head, very full and bushy Body stout, bear-like. Baird.

Gulo Luscus, *Wolverine.*

Sp. Ch.—The winter color, dark brown along the back. A broad band of much lighter yellowish brown passes from the shoulder downwards along each side to the root of the tail Forehead, cheeks, and nape of the neck grey. A number of yellow, orange, or white spots irregularly scattered from the throat to the foreleg. Feet and end of tail black. Dental formula incisors $\frac{3\,3}{3\,3}$, cansores $\frac{1\,1}{1\,1}$, premolars $\frac{4\,4}{4\,4}$, molars $\frac{1\,1}{2\,2}=\frac{18}{20}=38$.

The head of the Wolverine bears, in colouring and in shape, a strong likeness to that of the *M. Pennanti.* In general appearance and movements it greatly resembles the *Ursus Americanus*, as well as in the consistency and length of its fur. Its walk, however, is not nearly so plantigrade as that of the latter animal,

as is evident from an inspection of the soles of its feet, which are densely covered with hair. The head is broad and rounded, and the nose not so acute as in members of the genus *Mustela.* The eyes are small and far apart, the ears low and rounded, thickly covered on the outside with a long soft fur which nearly conceals them. The whiskers are comparatively short, stiff, and not numerous; and there are over each eye sparse tufts of similar hairs.

The body is long and stout, of great muscular power, and formed more for strength than activity. The feet are larger in proportion than those of any other species of the sub-family Martinæ, and are armed with strong claws, well curved and over an inch in length.

The skin which I propose now to describe is that of a female killed in last March. It is that of an average sized animal, whose coloration also is of the ordinary shades, and may be accepted with great propriety as a type of the species as found in this district. The pelage in winter is formed of a soft woolly under-fur, tolerably fine and about an inch deep and overlaid by larger and coarser hairs, which are about 3 inches long on the rump, but shortening gradually towards the head where they measure only half an inch. The feet are large and broad—the hind feet larger than the fore feet—and all densely covered with mingled fur and hair about $\frac{3}{4}$ of an inch in depth. The balls of the toes are naked, but from the thickness of the coverings of the feet, they leave no impression upon the snow. By careful examination three additional small bare pads will be discovered on each foot. The nails are strong, sharp, well curved, white, and upwards of an inch in length, those of the fore feet being, if anything, the stronger, though there is little difference either in length or shortness. Comparatively speaking the tail is rather short, very bushy, particularly towards the end, which has the appearance as if a piece were cut off. The fur covering it is of the same kind as that on the body, but the under fur is not so thick, and there are more of the coarse hairs which are here from 5 inches long at the root to 6 at the tip. The color of the fur varies much according to the season and age. The younger animals are invariably darker in the shadings than the old, which exhibit more of the grey markings. In the specimen under consideration, the back from the nape of the neck to the rump is a dark blackish brown perceptibly lighter on the

neck and shoulders. From the fore-leg a stripe of yellowish brown, about 3 inches broad, sweeps round each side, and grows lighter as it proceeds, passes over the tops of the thighs and ends at the root of the tail, giving the back of the animal almost the appearance of an Eskimo's tunic or shirt: and it is possible that these people may have borrowed their fashion from the Wolverine, whose fur is greatly in request among them. The colors of the head are thus arranged. From the nose to between the eyes and around them the hair is very short and is almost quite black. The forehead, ears, cheeks, and nape are of a brownish grey shade which gradually changes as it meets the darker tints and longer fur of the body. From the chin to the fore-legs along the throat, a black stripe of varied breadth extends, broken with large blotches of white or orange yellow. The belly is of the same shade as the back until near the anus, where a spot of bright orange yellow hairs extends to about four inches. The root half of the tail is light yellowish brown, and the top mostly black without any mixture of white hairs.

The legs and feet are black. There is a yellowish spot on the inner side of the fore-legs about half way down, and the fur of the soles is of a light brown tint. The summer pelage is of a light color, course and thin. In some specimens the yellowish fringing of the sides and rump is almost entirely white and of larger extent, leaving but a narrow stripe on the centre of the back dark. In such the hoary markings of the head would be of greater extent, and descend, most probably, to the shoulders.

In examining the skull of the Wolverine, the most striking points are the shortness and broadness of its muzzle, and the roundness of the cranium, giving promise of a certain quantity of reasoning powers, which the nature and habits of this animal do certainly not belie. The entire structure is massive, the skull and bones are thick and ponderous, and the muscles of the neck and limbs of immense volume. Indeed every requisite is apparently united to form a beast of extraordinary strength, and I do not wonder now at the almost fabulous feats, considering its size, that it has performed. The first measurements of the following table are taken from Prof. Baird's work on North American Mammals, and are inserted for comparison. He does not mention whether the specimen was measured before or after skinning, or whether it was an ordinary "case" skin, or purposely prepared for a Natural History specimen. If it be a common trading

peltry the measurements will appear of a much larger animal than the reality

	Dimensions of the skin in Smith. Institute from F. Union Nebraska	Dimensions of a female (March) from McKenzie River.
	Inches.	Inches.
Length from nose to eye		2.80
" " ear		6.10
" " occiput		6.90
" " to root of tail	36.00	34.80
Length of vertebræ of tail	9.00	8.00
" tail to end of hairs	14.00	13.00
Height of Ear		2.00
Length of forefoot with claws		4.40
" hind foot		5.60
" claws (average)		1.00
" upper canines		.90
" lower canines		.75
" longest hairs of tail	7.00	7.50
" " " of body	4.00	4.00

The habits and food of the Wolverine are similar to those of the Martin. It hunts birds, hares, mice, and will also occasionally kill disabled animals of the deer kind. But its greatest notoriety arises from the mischief which it does to the caches of meat, and trapping roads, both of the natives and white residents. The strongest caches built of green logs, and a foot in diameter, and dove-tailed it will manage to effect an entrance into. After satisfying its hunger, it is not yet contented, but carries off the remainder of the pieces of meat, even those weighing upwards of 100 lbs., transporting them to some distance and burying them in the snow.

By following the animal's footprints those hidden stores can be recovered ; but in general quite uneatable, as the wolverine to protect its secrct hoards from the attacks of other beasts of prey besprinkles all his larder plentifully with his urine, which has a strong and most disagreeable odour, and proves a good preservation in most cases. But the desire for accumulating property seems so deeply implanted by nature in this animal, that like tame ravens, it does not appear to care much what it steals so that it can exercise its favourite propensity to commit mischief. An instance occurred within my own knowledge in which a hunter and his family having left their lodge unguarded during their absence, on their return found it completely gutted, the walls were there, but nothing else. Blankets, guns, kettles, axes, cans, knives and all the other paraphernalia of a trapper's tent had vanished, and the tracks left by the beast shewed who had been the thief. The family set to work and by carefully following up all his paths recovered, with some trifling exceptions, the whole of the lost property. The damage which it does to a trapping road is very great, indeed, if the animal cannot be killed it is as well to abandon it as he will not only break the traps and eat the bait or animals caught, but also out of sheer malice will carry away the sticks and hide them at some distance. To kill or catch it is very difficult. An old stager is a regular bug-bear to the Indians. " Master," said one to me in his own language, " I cant hunt furs, the wolverine eats the martins and baits, and smashes my traps, I put a steel trap for him, he got in, but released himself by screwing off the nuts confining the spring with his teeth. I set a gun, he cut the cord attached to the trigger, ate the bait, and broke the stock, what shall I do ?" As the infallible strychnia had not then made its appearance in these parts, I could offer him neither advice nor assistance, and but little consolation.

Sub-family.—Lutrinæ.

Mustelida with the upper posterior tubercular molar large, quadrate. The number of molars the same in each jaw. Feet short, palmated. The typical otters bear a strong resemblance to the minks, the last mentioned group of the weasels, although the skull and teeth approximate much more nearly to the Melina. The body is elongated, the feet short, the toes palmated. The species are generally of large size and all more or less aquatic.

The group of the Otter embraces three principal genera; *Lutra*,

Pterura, *Enhydris*. The former again have been subdivided into those with claws well developed, and those with very rudimentary ones or none at all. *Pterura* is a distinct Genus, having the tail dilated laterally on either side. "Of *Lutra* N. America probably possesses two species, of *Enhydris* one." Baird.

Lutra Canadensis.—*American Otter.*

"Sp. ch. length about 4½ feet muzzle longer than wide, sending down a naked point along the median line of the upper lips anteriorly. Under surfaces of the feet so covered with hair towards the circumference as completely to isolate the naked pads of the tips. A hairy strip extending forward from beneath the carpus on the palm. Color above, liver brown barely lighter beneath, inferior surface and sides of head dirty whitish." Baird.

In appearance the otter is a magnified mink. Its walk, fur, and color bear strong similitudes to those of the latter animal, and the lightening of the tints of the pelage in old age is the same in both. Its fur is short and thick, the under fur being of a silvery white shade, slightly waved and silky, and of similar texture to that of the beaver but not so long. The color of the overlying hairs varies from a rich and glossy brownish black to a a dark chesnut. In summer the color is a rusty brown, and the fur is shorter and thinner. The habits of the otter are aquatic. From the shortness of its legs its motions on shore are not so quick as when in the water and as its food is principally fish, it resides in winter near some lake or river where it keeps a hole open in the ice all the season. During this period of the year its migrations on land are toilsome and it leaves a deep furrow or path in the snow, which when seen by the trapper soon after the animal has passed, invariably leads to the distruction of the animal. If a trap be set on this road the otter is nearly certain to be caught, as it has a strong objection to opening new paths through the deep snow. In firing at an otter in the water care must be taken not to shoot it in an immediately vital part as if death ensue instantaneously the body will sink like a stone.

Whether the *Lutra Californica* be found in this district, or whether that animal be only a variety of the species under consideration I cannot say: but an examination of a greater number of specimens will, in time, determine the matter.

Family.—URSIDÆ.

"Fam. Ch. Toes distinctly separated, five on each foot; walk plantigrade; coccum wanting. The sectorial tooth and the molars behind them tuberculated.

URSUS.—*Linn.*

Gen. Ch. Body thick, clumsy, and large. Feet entirely plantigrade; soles naked; nails long; tail very short; head very broad. Dentition. incisors $\frac{3}{3}$:$\frac{3}{3}$ canines $\frac{1}{1}$:$\frac{1}{1}$ premolars $\frac{4}{4}$:$\frac{4}{4}$ molars $\frac{2}{3}$:$\frac{2}{3}$ $\frac{2}{2}\frac{0}{2} = 42$." BAIRD.

Of this sub-family those found in this district will probably be: 1. *Ursus Americanus.* 2. *Ursus Horribilis.* 3. *Ursus Maritimus*, and 4. *Ursus Arctos* or Barren Ground Bear.

Of the identity of the second and fourth of these, I am not by any means certain, and one at least, if not both, will probably be found to be an unnamed if not an undescribed species.

ARTICLE III.—*Addenda to the Natural History of the Valley of the River Rouge.* By W. S. M. D'Urban.

(*See pages* 81—99 Vol. V.)

LEPIDOPTERA.

The names and descriptions of the following species were not received from Mr. Francis Walker in time for publication in their proper places, in the second part of the "Natural History of the River Rouge," contained in the April number of this Magazine.

Sphingina.—Family, Ægeriidæ, *Steph.*

Thyris vitrina, Boisd. Bevin's Lake, Montcalm, 5th July.

Bombycina.—Family, Liparidæ, *Walker.*

Dasychira clandestina, Walker, M. S. S., n. sp. Bevin's Lake, Montcalm, 7th July.

"*Mas.* Cinerea, nigroraria, densè pilosa; antennæ breves, latè pectinatæ; pedes breves, pilosissimi; alæ nigro nebulosæ, lineis quatuor denis undulatis nigris apud costam dilatatis."

"*Male.* Cinereous, varied with black, thickly pilose. Antennæ short, broadly pectinated. Legs short, very pilose. Wings partly shaded with black, with four irregular undulating black lines which are dilated on the costa of the forewings; under side paler, with the lines obsolete except by the costa. Length of the body 6 lines, of the wings 14 lines." *Walker, M.S.S.*

Audela. N. G. Walker, M.S.S.

Mas. Corpus crassum, pilosissimum. Proboscis brevis, tenuis. Palpi breves, graciles, obliquè ascendentes ; articulus 3us longi-conicus, 2i dimidio brevior. Antennæ subpectinatæ, ramis subclavatis. Abdomen depressum, apice quadratum, alas posticas paullo superans. Pedes robusti, pilosissimi, calcaribus breviusculis. Alæ validæ ; anticæ apice subrotundatæ, margine exteriore vix convexo sat obliquo."

"*Male.* Body thick, very pilose. Proboscis short, feeble. Palpi short, slender, obliquely ascending ; third joint elongate-conical, less than half the length of the second. Antennæ slightly pectinated ; branches subclavate. Abdomen depressed, quadrate at the tip, extending a little beyond the hind wings. Legs stout, very pilose ; spurs rather short. Wings stout, moderately broad. Forewings somewhat rounded at the tips ; costa straight ; exterior border hardly convex, rather oblique ; interior angle not prominent."

Audela acronyctoides, Walker, M.S.S., n. sp. Township of Montcalm, June.

"*Mas.* Albida, nigro-varia ; antennæ fulvæ ; abdomen nigricans, segmentis albido marginatis ; alæ anticæ nigricantes, fasciis tribus albidis, 1a lata diffusa informis, 2a 3a que angustis angulosis subparallelis, liturâ discali obliquâ sublunatâ nigro marginatâ ; posticæ pallidè cinereæ, trilineatæ."

"*Male.* Whitish, mingled with black. Antennæ tawny. Abdomen blackish ; hind borders of the segments whitish. Legs mostly black ; tarsi with white bands. Forewings blackish with three whitish bands, first band broad, diffuse, very irregular ; second and third slender, zigzag, nearly parallel to each other ; discal mark oblique, sublunate, black-bordered ; fringe blackish, with white streaks opposite the veins. Hindwings pale cinereous ; discal mark, one interior and two diffuse undulating exterior lines, dark cinereous : marginal line black. Length of the body 9 lines ; of the wings 18 lines." *Walker, M.S.S.*

Family, Notodontidæ, *Steph.*

Heterocampa semiplaga, Walker, M.S.S., n. sp. Common, Township of Montcalm, June.

"*Mas et Fœm.* Cinerea, densè pilosa, olivaceo subtincta ; palpi obliquè ascendentes ; thorax posticè et abdomen basi nigra ; alæ nigro nebulosæ, lineis tribus nigris denticulatis indistinctis, linea marginali nigra, fimbria nigro punctata ; anticæ linea submarginali e guttis nigris."

"*Male and Female.* Cinereous, thickly pilose, with a slight olive-green tinge, whitish cinereous beneath. Palpi distinct, obliquely ascending, nót extending beyond the frontal tuft. Thorax by the hind border and abdomen at the base black. Wings partly clouded with black, adorned with three indistinct irregular denticulated black lines ; marginal line black ; fringe with black points. Fore-

wings somewhat rounded at the tips, with a submarginal line of black dots. *Male.* Antennæ tawny, moderately pectinated to three-fourths of the length. *Female.* Antennæ simple. Length of the body 9 lines ; of the wings 20 lines. *Walker, M.S.S.*

Noctuina.—Family, Bryophilidæ, *Guén.*

Bryophila? spectans, Walker, M.S.S., n. sp. Township of Montcalm, June.

"*Mas.* Alba, nigro varia ; palpi lanceolati, caput superantes, nigro fasciati ; abdomen cinereum, segmentis albo marginatis ; alæ anticæ lineis duabus nigris duplicatis valdè dentatis, 2a valdè flexa, orbiculari et reniformi e annulis duabus magnis incompletis nigris, guttis marginalibus nigris ; posticæ litura discali lineaque dentata undulata nigricantibus."

"*Male.* White, varied above with black. Palpi lanceolate, extending somewhat beyond the head ; second joint with a black band. Abdomen cinereous, white at the tip and on the hind border of each segment. Tarsi with black rings. Forewings with two pairs of very dentated black lines, of which the outer pair is much bent, orbicular and reniform marks forming two large incomplete black ringlets, of which the outer one has the usual form ; marginal dots black. Hindwings above and below, and forewings below, with a discal mark and an undulatiug dentate line blackish. Length of the body 5 lines ; of the wings 14 lines." *Walker, M.S.S.*

Family, Bombycoidæ, *Guén.*

Microcelia? retardata, Walker, M.S.S., n. sp. Locality not recorded.

"*Mas.* Pallide cinerea ; palpi obliquè ascendentes, nigro fasciati, articulo, 3o longiconico ; antennæ breviusculæ ; alæ anticæ lineis, tribus dentatis nigris, linea 1a basali, 2a 3a que duplicatis, 3a flexa orbiculari et reniformi nigricante notatis et marginatis, fimbria nigro punctata ; posticæ litura discali lineaque exteriore undulata nigricantibus."

"*Male.* Pale cinereous. Palpi obliquely ascending, not rising higher than the vertex ; second joint with a broad black band ; third elongate-conical less than half the length of the second. Antennæ rather short. Abdomen not extending beyond the hindwings. Forewings with five dentated black lines, of which one is basal, and the other four form two pairs which are remote from each other, the outer pair much bent ; orbicular and reniform marks large, of the usual form, with blackish disks and black borders ; fringe with black points ; underside and hind wings with a discal mark and an undulating exterior line blackish, these are most distinct on the under side of the hind wings. Length of the body 4½ lines ; of the wings 14 lines." *Walker, M.S.S.*

Family, Noctuidæ, *Guén.*

Agrotis spissa? Guén. Hamilton's Farm, August.

Family, Orthosiidæ, *Guén.*

Cerastis anchocelioides, Guén. Township of Montcalm, June.

Geometrina.—Family, Ennomidæ, *Guén.*

Hyperetis alienaria, Herr Sch. Township of Montcalm, June.
Endropia refractaria, Guén. Common near Hamilton's Farm, 4th September.
Azelina Hubneraria, Guén. Locality not recorded.

Family, Boarmidæ, *Guén.*

Cleora limitaria, Walker, M.S.S., n. sp. Sixteen-Island Lake, May.

"*Fœm.* Albida; palpi nigri, brevissimi, caput pallo superantes; alæ antice lineis quinque dentatis undulatis nigris, fasciis tribus fuscente cinereis, 3a posticè abbreviata, linea marginali e punctis nigris; posticæ gutta discali, lineis duabus, exterioribus indistinctis." *Walker, M.S.S.*

"*Female.* Whitish. Palpi black, very short, rising very slightly above the head. Antennæ pale cinereous. Forewings with five dentated, undulating black lines, and three brownish-cinereous bands, the third abbreviated behind: the marginal line spotted with black. Hind wings with a faint discal spot, and two exterior indistinct lines. Length of the body 4½ lines; of the wings 14½ lines."

Cleora diversaria, Walker. Township of Montcalm, June.
" *distinctaria*, Walker. Sixteen-Island Lake, Montcalm, May.
Boarmia converzaria, Walker, M.S.S., n. sp. Township of Montcalm, June. (Description omitted).
" *inordinaria*, Walker, M.S.S., n. sp. Township of Montcalm, June. (Description omitted).
" *cunearia*, Walker, M.S.S., n. sp. Abundant, Sixteen-Island Lake, Montcalm, May. (Description omitted).
" *divisaria*, Walker, M.S S., n. sp. Township of Montcalm, June. (Description omitted).
" ? *patularia*, Walker, M.S.S., n. sp. Very numerous, Sixteen-Island Lake, June. (Description omitted).

Family, Acidalidæ, *Guén.*

Acidalia junctaria, Walker, M.S.S., n. sp. Locality not recorded.

"*Fœm.* Candida; caput antice nigrum; palpi brevissimi; thorax antice testaceus; alæ nigro subconspersæ, lineis duabus testaceis indistinctis obliquis."

"*Female.* Pure white. Head black in front. Palpi very short. Foreborder of the thorax testaceous. Legs slightly testaceous-tinged. Wings very minutely black speckled with two indistinct oblique testaceous lines. Length of the body 4 lines; of the wings 11 lines." *Walker, M.S.S.*

Family, Caberidæ.

Corycia hermineata, Guén. Township of Montcalm, June.

Family, Macaridæ.

Macaria ? subapiciaria, Walker, n. sp. Locality not recorded.

"*Mas.* Albida, gracilis; palpi breves, subascendentes; antennæ pubescentes; alæ fusco densè conspersæ, litura discali fusca, punctis marginalibus nigris; anticæ lineis quatuor fuscis diffusis indistinctis nigricante notatis; posticæ angulatæ."

"*Male.* Whitish, slender. Palpi short, slightly ascending, extending very little beyond the front. Antennæ pubescent. Wings thickly speckled with brown; discal mark brown; marginal points black. Forewings with four diffuse and very indistinct brown lines, which are distinguished by some blackish marks, and end on the costa in four blackish spots; the adjoining spaces more white than the wings elsewhere. Hind wings with the exterior border angular. Length of the body 5 lines; of the wings 14 lines." *Walker, M.S.S*

Family, Larentidæ, *Guén.*

Melanippe propriaria, Walker, M.S.S., n. sp. Common, Sugar-bush Lake, Montcalm, June.

"*Fœm.* Nigra; corpus subtus albidum; palpi porrecti, brevissimi; anticæ fascia exteriore lata nivea apud angulum interiorem subfurcata."

"*Female.* Black, slender. Body and legs whitish beneath. Palpi porrect, very short, hardly extending beyond the front. Forewings with a broad exterior upright snow-white band, which is slightly furcate by the interior angle. Length of the body 3½ lines; of the wings 10 lines." *Walker, M.S.S.*

Cosemia ? palparia, Walker, M.S.S., n. sp. Locality not recorded.

"*Mas.* Cinerea fusco-conspersæ; palpi porrecti, longi, compressi, pilosi; alæ anticæ fascia obscure fusca lata albido marginata, extus undulata, intus postice dilatata, linea exteriore indistincta angulosa obscure fusca, gutta subapicali punctisque marginalibus nigris, fimbria albo punctata."

"*Male.* Cinereous, brown-speckled. Palpi porrect, long, compressed, pilose, extending rather far beyond the head. Forewings with a broad dark brown band which is undulating, whitish-bordered and slightly angular on the outer side, and is diffuse on the inner side, except hindward, where it is dilated and whitish bordered, and forms a prominent angle; space near the exterior side of the band whitish, succeeded by an indistinct zigzag dark brown line, which is accompanied by a brown spot on each border; subapical dot and marginal points black; fringe with white points. Hindwings with a blackish marginal line. Length of the body 5 lines; of the wings 14 lines." *Walker, M.S.S.*

Cidaria lactispargaria, Walker, M.S.S., n. sp. Abundant at Sixteen-Island Lake, May.

"*Mas.* Pallide fusca; palpi brevissimi; alæ linea alba undulata informe incompleta nigricante notata, punctis marginalibus nigris; antice litura discali nigricante, linea interiore nigra undulata."

"*Male.* Pale brown. Palpi very short. Abdomen and hindwings cinereous, brown speckled; the former with a compressed apical tuft. Wings with an undulating irregular, incomplete blackish marked white line, and with black marginal points. Forewings with the middle part somewhat darker, with a blackish discal mark, and with a black interior, irregular, undulating line. Length of the body 5 lines; of the wings 13 lines." *Walker, M.S.S.*

Pyralidina.—Family, Botydæ, *Guén.*

Botys magniferalis, Walker, M.S.S., n.sp. Sugar-bush Lake, Montcalm, June.

"*Mas.* Alba, subiridescens; palpi extus fusci; thorax fusco subconspersus; abdomen fusio fasciatum; alæ anticæ fusco variæ, maculis duabus magnis anticis fuscis, fimbria fusco inter lineata; posticæ fusco conspersæ."

"*Male.* White, slightly iridescent. Palpi brown on the outer side. Thorax slightly speckled with brown. Abdomen with irregular dark brown bands. Forewings excepting the discal part mottled with brown; two large brown spots extending from the costa to the disk, the inner one narrower than the outer one and not half its length; fringe diffusedly interlined with brown. Hindwings irregularly speckled with brown. Length of the body 5 lines; of the wings 14 lines." *Walker, M.S.S.*

Eubulea tertialis, Guén. This is the species mentioned at p. 95 of Volume V, as so abundant on Raspberry blossoms in July, at Bevin's Lake, Montcalm.

NOTE.—The new species mentioned above without descriptions, will probably be described in the British Museum Catalogues of the Geometrina now publishing.

The following three species of *Neuroptera* were determined for me at the British Museum:—

Polystœchotes nebulosus, Fabr. (*sticticus*, Buin.) and *Osmylus validus*, Walker. This fine insect is very numerous in August in the present district, and also about Montreal near water. It flies at all hours of the night, often dashing into one's face, and with its large soft, gauzy wings communicates a very unpleasant sensation, especially to a solitary watcher by a lonely camp fire in the backwoods. It closes its wings and falls head foremost to the ground immediately it strikes against any object, and remains motionless for a few seconds before again taking wing. It is much attracted to light.

Hermes maculatus. Common, flying by day in July the whole way up the Rouge. I have also taken it at Sorel, and it occurs in the Eastern Townships. It generally hovers over the water.

Panorpa subfurcata. Observed at Bevin's Lake, Montcalm; Huckleberry Rapids, De Salaberry; and Hamilton's Farm; July to September.

Although the *Diptera* are so very numerous, not only in species but in individuals, that they are without exaggeration the worst evils of back-woods life, witness the various species of "Deer-fly" (*Tabanus*), Golden-eye (*Chrysops*), "Black-fly" (*Simulium*), Mosquito (*Culex*), and "Sand-fly," all of which are more or less annoying. I am sorry to say I collected but a few specimens some of which were destroyed and most of the others I have been unable to determine.

The *Hymenoptera* collected will be noticed elsewhere.

Exeter, Devonshire, June 2nd, 1860.

ARTICLE IV.—*On the occurrence of Freshwater Shells in some of our Post Tertiary Deposits.* By Robert Bell.

(Presented to the Natural History Society of Montreal.)

The various deposits described in the following paper are of different ages and have been formed under very different circumstances, but are arranged under the same head for the sake of convenience.

Montreal.

Early in the spring of 1858 I accompanied Mr. D'Urban, who has done much for the cause of Natural History in Canada, on several excursions to collect fossils at the localities in the vicinity of Montreal where drift shells had been discovered. In examining the sides of Mr. Peel's clay pits, which are excavated in the 120 feet terrace, we discovered a few specimens of *Limnœa caperata*, Say, in place, in a thin layer of sand immediately above the Leda clay and more than three feet below the surface of the ground, which is level at the place. In the same bed with these fresh water shells *Saxicava rugosa*, *Tellina grœnlandica*, *Mya arenaria*, *Mya truncata* and *Mytilis edulis* are associated; and in the clay immediately underlying it *Leda Portlandica* was found, but not in any abundance.

About the same time that this Limnæa was found at Mr. Peel's

brick yard, I received a fine specimen of *Limnœa umbrosa*, Say, from Sir Wm. Logan, who obtained it from the thin bed of sand at the same locality. A *Cyclas* and *L. umbrosa* were found by Dr. Dawson amongst marine shells thrown out of a ditch on Logan's Farm.* I have collected specimens of the latter at the same place and believe them to be contemporaneous with the marine shells.

I might mention that the ponds on the highest part of Montreal Mountain, about 700 feet above the level of the sea, teem with *Limnœa umbrosa* and *L. caperata*, besides numerous other species of our common fresh water Gasteropods. Ponds, with all these species living in them, may have existed in the same situation when Montreal Mountain was an island in the sea which covered the surrounding plain, and from them the rills running down its sides may have carried the specimens found in the sand which was then being deposited around its base.

Green's Creek.

Green's Creek enters the Ottawa in the Township of Gloucester, on the south side, about ten miles below Ottawa City. Here, the Leda clay has afforded a larger number and more interesting variety of fossils than at any other locality. At low water, which is generally in the month of September, the shore of the Ottawa for about two miles from the mouth of the creek upwards, is strewn with nodules of all manner of curious shapes washed from the base of the steep bank of clay which rises from high water mark.

In looking over the collection of nodules from this locality in the Museum of the Geological Survey, I found two specimens of *Limnœa stagnalis*, one of our commonest living species. Both had been partially filled with clay, now a hard stone, while they still retained their original shape. With the exception of the splendid *Limnœa megasoma*, which inhabits the Ottawa valley, this is the largest species in Canada. It was called *L. jugularis* by Say, but is identical with the European *L. stagnalis*. One meets with these shells in almost every warm marsh or pond on the south side of the Ottawa, and it is interesting to know that their progenitors lived in this country while the Leda clay was being deposited and a deep sea covered their present abode.

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* Canadian Naturalist, vol. iv. p. 36, vol. 11, p. 422.

Not only have marine shells and this fresh water species been found at Green's Creek, but also the remains of two seals, three kinds of fish, leaves, wood and nuts of land plants, three or more species of marine algæ and specimens of *Asteracanthion polaris* Müll, the most abundant starfish now inhabiting the Lower St. Lawrence, and future researches at this locality will no doubt add many more fresh water, as well as marine species, to our Post Pliocene fauna.

Terraces around Lake Ontario.

On the south side of Lake Ontario a remarkable ridge* composed of loose materials, extends from Sodus in Wayne County wesward to Lewiston on the Niagara River, a distance of 100 miles, and a continuation of the same ridge has been traced to the head of the lake. The general contour of this "Lake Ridge," as it is called, is parallel to the present shore of the lake, its extreme variations being three miles at its least and eight at its greatest distance from the shore. A carriage road runs along its summit, the general elevation of which is so uniform, that when the road is tolerably straight, a traveller can be seen as far as the eye can reach. A remarkable feature of this ancient boundary of the lake is that it declines more or less on the inland, as well as the lake side, thus constituting a true ridge, which damming the surface water, forms marshes on the upper side. This fact can be no objection to the supposition of its marking a former boundary of the lake, for we find similar ridges now forming along low exposed shores. The rarity of shells in it, is perhaps as a circumstance in favour of the supposition of its being of fresh water, and not marine origin, as shells are very scarce along the open shores of the great lakes, and one might search a long time in similar ridges now forming without finding any.

The elevation of the summit of the ridge above Lake Ontario opposite Middleport is 185 feet, opposite Albion and Brockport it is 188 feet. The distance comprised within these three observations is thirty miles, in which the elevation of the ridge varies only three feet; in Wayne County it is estimated at 200 feet. Fragments of wood, shells, &c., are found embedded in it; the shells were not collected by Mr. Hall himself but he has no doubt

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* The facts here given in regard to the "Lake Ridge" are derived from Hall's Geology of New York, Part IV.

of their occurrence. In his annual report of 1838 he remarks that *Uniones* are said to have been found in the ridge. Should the shells of this deposit prove to be of fresh water origin, and since no marine shells have been found in it, we might be induced to believe that Lake Ontario once stood far above its present level, and that a barrier which kept it at that level has since been removed; but on the contrary, as there is no actual proof that such a barrier did exist, we have reason to conjecture that it was formed while the sea stood at that level. Allowing the water by which the Lake Ridge was thrown up to have been 175 feet over the present level of Lake Ontario, we should have about 410 feet as its elevation above the present sea level; this corresponds exactly with that of the littoral deposit in Nepean on the Ottawa, in which Sir Wm. Logan has found marine shells, and it would not be surprising if future researches prove them to be contemporaneous—perhaps also with the terrace on the back of Montreal Mountain which is 50 or 60 feet higher,—for littoral deposits at considerable distances apart may be of the same age though at different elevations, as these differences may be due to an unequal amount of upheaval or to a difference in the heights to which the tides rose.

One of the numerous terraces which run along the north side of the lake will no doubt be found to mark an elevation corresponding to that of the "Lake Ridge" on the south; probably the "Pine Ridge" which is so well marked is the one. The late Mr. Roy, who long ago levelled the terraces behind Toronto, gave 108, 208, 280, 308, 344, 420, 680 and 762 feet as the elevations there of ancient beaches above Lake Ontario.

Dr. Dawson the other day showed me two specimens of a *Melania* and one of *Unio ellipsis* from a sandy deposit not far from Toronto.* They are described as having been found immediately above the Silurian rock in the drift about five miles from the Asylum. Both the *Melanias* are filled with sand but on the back of the *Unio* there is a thin layer of clay which again is impregnated with sand. The deposit from which these shells are derived may be of the same age as the ridge on the other side of the lake.

Professor Chapman informs me that he has collected specimens of a *Planorbis* in sand and gravel about 46 feet above the lake in the neighbourhood of Belleville.

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* Collected by B. Workman, Esq., M.D.

Although some of the lower terraces behind Toronto might have been formed by the lake when at a greater elevation, the higher ones were doubtless formed during the period of the glacial drift.

I will mention a circumstance which may be one reason for inferring that Lake Ontario was filled with fresh water at the time when the sea stood at one of the best marked zones of the Post Pliocene formation to the eastward. It is well known that the very common little bivalve *Tellina grœnlandica* delights in salt water which is largely mixed with fresh and is most abundant in friths or bays where rivers enter the sea. In descending the St. Lawrence from Quebec, it is the first marine shell one meets with and is extremely abundant when the upper limit of other marine species is reached. When the salt water extended up the valley of the St. Lawrence to some point between Montreal and Kingston, we should naturally expect the same state of things to have existed. Now, in the drift deposits at Prescott, at about 250 feet above the sea, *Tellina grœnlandica* is very abundant and I did not observe any other species; from this fact, and considering the situation of the locality, it appears evident that the estuary was here diluted with fresh water when the sea stood at this level, but the argument is open to many objections.

Niagara Falls.

In 1859 an opportunity was afforded me of examining the ancient bed of the Niagara River near the Falls. Between the Clifton House and the toll-gate below, a deposit of gravel and sand, rich in fluviatile shells, occurs between the ancient bank of the river, and the cliff overhanging the present gorge. At a spot on the road-side where a quantity of the sand and gravel had been excavated, I collected the following species :—

1. *Planorbis bicarinatus.*
2. *Physa heterostropha.*
3. *Limnœa caperata.*
4. " *stagnalis.*
5. *Melania Niagarensis.*
6. " *conica.*
7. " *acuta.*
8. *Paludina decisa.*
9. *Amnicola porata.*
10. *Unio gibbosus.*
11. " *complanatus.*
12. " *ellipsis.*
13. " *rectus.*
14. *Margaritana marginata.*
15. *Cyclas similis.*
16. *Psidium dubium ?*

A portion of a land snail, probably *Helix albolabris* was also

found. Many of the bivalves were perfect, having the valves closed, and from the position in which they were found, appeared to have lived on the spot where they are buried. These shells may have lain here for thousands of years, although their geological date is extremely recent.

Similar terraces occur on Goat Island, and along the American side of the river from the Falls to the whirlpool. A mastodon's tooth was found in this fluviatile terrace opposite Goat Island, at a depth of nine feet below the surface, but it does not follow from this, that the mastodon lived at the time of its formation, for the tooth might have been washed from an older deposit. These terraces being all on the same level, and the *Uniones* occurring in them in the position in which they had lived, are facts which imply that they were once connected so as to form a continuous stratum, extending over the position occupied by the present gorge, and also that they have been deposited in a tranquil widening of the river, like that between Chippawa and Buffalo. They also afford a conclusive proof that the Falls have receded. These terraces are described by Hall, Lyell and Ramsay.

Terraces around Georgian Bay.

The more inaccessible parts of the Province have naturally received less of the attention of scientific men, than those in the vicinity of her cities or along her great thoroughfares. I am not aware of anything having yet been published in regard to the lake terraces of the region under notice, with the exception of a paper by Sandford Fleming, C. E., on "The Valley of the Nottawasaga,"* from which I extract the following :—

"There are appearances in various parts of this region which lead us to infer that the waters of Lake Huron like those of Ontario, formerly stood at higher levels than they at present occupy. Parallel terraces and ridges of sand and gravel can be traced at different places winding round the heads of bays and points of high land with perfect horizontatlity, and resembling in every respect the present lake beaches ; one of them particularly strikes the attention in the Bay of Penetanguishene, at a height of about 70 feet above the level of the lake ; it can be seen distinctly on either side from the water, or by a spectator standing on one bank while the sun shines obliquely on the other, so as to throw the deeper parts of the terrace in shadow. The accompanying section, sketched† from a cutting a little below Jeffrey's tavern, in the Village of

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* Read before the Canadian Institute in 1853, and published in the first volume of the Canadian Journal.

† This sketch resembles a cross section of a side-hill road, where the earth has been excavated on the upper and thrown to the lower side.

Penetanguishene, will serve to show the manner in which the soil has been removed from the side hill and deposited in a position formerly under water, by the continued mechanical action of the waves. Not only does the peculiar stratification of the lower part of the terrace confirm the supposition that it was deposited on the shore of an ancient lake, but the fact that such excavations have been made in this land-locked position, where the waves could never have had much force, goes far to prove that the lake stood for a long period at this high level.

"Another ancient beach mark about 15 miles inland, and as far as yet ascertained, about the same level as the one at Penetanguishene, can be traced for a long distance in the township Tosorontio. It passes through the tract of burnt land already described, the soil of which being pure sand, in all probability formed the shoals of a lake extending to the north and east, the outline of which is approximated by the dotted line* marked from 70 to 80 feet high on the accompanying map. Nor are these the only traces of old lake beaches met with in this region, although the dense forest nearly everywhere covering the surface is a great impediment to their easy discovery. In the Township of St. Vincent, near the village of Meaford, besides a very conspicuous one, corresponding in level with those already mentioned, several others of lesser note are found at various heights; at Owen Sound, also, they are remarkably well defined; while Cape Croker, on the western side of Georgian Bay, viewed even from a distance and the well remembered shape of the Giant's Tomb, on the eastern, show striking evidences of having been acted on for ages by the storms of Lake Huron, when at a higher level.

"It has been said that some of these terraces are estimated at 70 or 80 feet feet above the level of the lake; by drawing a contour line coinciding with this height around the lower part of the valley, it is found that the high ridge of sand now in some parts blown up into dunes near the mouth of the River (Nottawasaga), will form a narrow neck of land (supposing the lake at its former level), stretching across from shore to shore, and resembling in many respects the "Burlington Beach," on Lake Ontario, and also "Fond-du-Lac," on Lake Superior; like the first it encloses a bay of considerable depth of water, but of far greater area. That this ridge has been formed in a manner precisely similar to those two, by the sand washed from the adjoining shores, there is great probability, in fact there is good reason to believe that the same natural agents, at present in active operation moving the outlet of the river eastward, have also formed this upper ridge by transporting the materials of which it is composed, from the base of the escarpment in Collingwood.

"In attempting to arrive at the geological age of these ancient beaches, it will be necessary to show whether their position, at a consi-

* This line encloses a subtriangular space, having one corner in the north of Nottawasaga, another in the centre of Essa, and the third in the north-east corner of Vespra.

derable height above the level of the lake may be attributable to a gradual elevation of the land or to a subsidence of the water. The last hypothesis seems the most tenable, since the first would involve a local upheaval only, and an inclination of the plane of the terraces at variance with their apparent horizontality. Should further researches prove the existence of terraces or other indications of old beaches on the western margin of Lake Huron corresponding in height with those discovered along the eastern shore, the supposition that the level of the water has been lowered by the wearing away of some barrier will be strongly supported; and if this be allowed as a reasonable explanation for these geological monuments, we have then, by drawing contour lines coinciding with their level the means of discovering the probable position of this barrier. From all that I can learn regarding the relative levels of the country these lines would pass over the peninsula between Lakes Huron and Erie at some distance inland from the River St. Clair and would if continued eastward along the shores of Lake Erie fall within the summit of the neck of land through which the chasm of the Niagara River is cut."

The northern part of the Township of Nottawasaga is situated on the extensive sandy plain above alluded to, which was no doubt formerly covered by an extension of Georgian Bay to the south-eastward. The whole has a general slope up from the bay, but here and there a ridge of gravel or coarser sand interrupts its general uniform aspect. Hurontario Street, running from Collingwood Harbour almost due south through the township, was carefully levelled by Wm. Gibbard, C. E., and it appears from his profile section of the street, that from Collingwood to the north side of the Pretty River at the Village of Melville or Nottawa Mills, a distance of two and a half miles, the ground rises very regularly from the edge of the water to an elevation of 138 feet, or at the rate of about 55 feet per mile. At the Pretty River a change begins both in the character of the surface and in the rate of its inclination, which continues regularly for three and a half miles further at 47 feet per mile. Thus, at a distance of six miles from the present shore, the surface has attained an elevation of more than 300 feet above the level of the lake; beyond this it rises irregularly and much more rapidly. It is evident that the bank of sand and gravel on the north side of the Pretty River continued for a long time to be the shore of the lake. The layers of sand and gravel are arranged exactly as on a modern beach, and among them I noticed several thin irregular beds of a light grey or white colour, composed principally of carbonate of lime. In the cutting through the top of this ridge the common land shells *Helix al-*

bolabris, *H. tridentata*, *H. Sayii*, *H. alternata*, and *H. fuliginosa* were collected, at from three to four and a half feet below the surface.

About a mile south of Collingwood, a shallow cutting for the road, exhibits the arrangement of the beds of sand and gravel, which at the base of the exposure dip southward at an angle of 35° and are overlaid to the surface by unconformable horizontal layers. Here, from the surface to a depth of three feet, *Planorbis trivolvis* and *Helix fuliginosa*, *H. tridentata* and *H. thyroides?* were found. The summit of this rise is 78 feet above the level of the lake, and from its plotted section appears to have been thrown up by the waves when the edge of the lake ran along the base of its northern slope.

There are a few specimens of *Melania conica* in the Geological Museum, from a railway cutting in sand near Collingwood.

The greater part of the town of Owen Sound is built on a loose deposit of gravel and fine sand at the head of a long arm of the Georgian Bay of the same name. The flat formed by this deposit slopes gradually up from the head of the bay towards the falls of the Sydenham River, which has cut its way through it, and is bounded on either side by terraces of Silurian limestone or marl. Fresh water shells were observed in abundance wherever a section of the sand was exposed, and also, in one place, *Helix alternata* the most abundant land shell on the shores and islands of Lake Huron.

The following species were collected in different places in the most central part of the town. One of these, on the bank of the river was about nine feet above the level of the lake; the others appeared to be a little higher.

1. *Limnœa umbrosa.*	7. *Melania conica.*
2. *Planorbis campanulatus.*	8. *Paludina decisa.*
3. " *bicarinatus.*	9. *Valvata sincera.*
4. " *parvus.*	10. " *tricarinata.*
5. *Melania acuta.*	11. *Amnicola porata.*
6. " *Niagarensis.*	12. *Cyclas similis.*

About a mile south from the mouth of the river, or following the upward course of the valley, the road is cut through a slight elevation in this lacustrine deposit and here also fresh water shells were found embedded in the sand, but neither the species nor individuals

were so numerous as in the same deposit nearer the head of the bay. I had no means of ascertaining the elevation of this spot above the lake, but it seemed to be more than 30 feet and the shells bore evidence of great antiquity.

The terraces before alluded to as bounding this flat are capped with fine sand and their summits appeared to exceed 80 feet above the level of the lake. They are well marked and extend for miles along each shore of the Sound. At Peiett's Harbour, or the French Village on the west side of Owen Sound and about twelve miles from the town of the same name, two steep and very well marked lake terraces rise, one above the other, near the water's edge. They are both composed, as far as I examined them, of shingle mixed with a little silt. The summit of the upper one appeared to be about 100 feet above the lake and is in all probability the continuation of the upper terrace running round the head of the Sound, while the lower one corresponds to that on which the town is built.

When Lake Huron was at a sufficient elevation to form the higher of these terraces, it was probably connected by a wide expanse with Lake Erie, which is also proved to have stood at this high level from the fact of a ridge holding fragments of decayed wood and fresh water shells, running along its southern side at an elevation of 150 feet above its present level.

MONTREAL, *Feb. 4th*, 1861.

ARTICLE V.—*Professor Guyot on the Physical Geography of the Appalachian Mountain System.*

The great Appalachian backbone of Eastern America though much visited in some of its peaks by tourists, penetrated by many roads, and stretching through the midst of a civilised country, has hitherto been little known to Physical Geographers in its details. Prof. Guyot has made it a special subject of study since his arrival in America; and since 1849 has devoted his summer excursions to the accurate barometrical measurement of its elevations at various points throughout its whole length. The results, including details of the methods of observation employed, and a table of the heights of all the principal peaks, table-lands and gaps, are published in Silliman's Journal; from early sheets of

which kindly forwarded to us, we extract the following general conclusions as to the physical structure of the chain.

" The upheavals of ancient rocks which constitute this well connected physical structure, for which, as a whole, it is proper to retain the common name of the Appalachian system, extend in an undulating line thirteen hundred miles in a mean direction of N. E. to S. W., from the promontory of Gaspé upon the Gulf of St. Lawrence to Alabama, where the terminal chains sink down and are lost in the recent and almost horizontal strata of the cretaceous and tertiary formations which cover the greater portion of the surface of this state. This long range of elevations is composed of a considerable number of chains, sensibly parallel to each other, occupying more particularly the eastern part which faces the ocean, and of an extended plateau which prevails towards the west and northwest and descends gradually towards the inland valleys of the St. Lawrence, the lakes Erie and Ontario and the Ohio River.

The base on which this large belt of mountains rests, and which may be considered as bounded by the Atlantic Ocean on one side and by the Ohio and St. Lawrence Rivers on the other, is formed, in the east, by a plain slightly inclined towards the Atlantic. The width of that plain, in New England, does not vary much from fifty miles. Near the mouth of the Hudson, however, in New Jersey, it nearly disappears, but gradually increases towards the south to a width of over two hundred miles. Its elevation above the sea, at the foot of the mountains, is in New England, from 300 to 500 feet. From the neighborhood of the bay of New York, where it is nearly on a level with the ocean, it rises gradually towards the south to an altitude of over 1000 feet. On the west the table-lands which border upon the Ohio River, and which may be considered as the general base of the system, preserve a mass-elevation of a thousand feet or more, in the thickness of which the river bed is scooped out to the depth of from 400 to 600 feet, thus reducing the altitude of the Ohio River full one-half from that of the surrounding lands.

The vast belt of the Appalachian highlands forms the marginal barrier of the American continent on the Atlantic side, and determines the general direction of the coast line, which in general, runs parrallel to the inflections of its chains with remarkable regularity. This system, composed of a series of corrugations tolerably uniform, does not, like the Alps, or the other great systems of fracture, have a central or main axis, to which the secondary chains are subordinated. But it is properly compared to the system of the Jura, for it is composed like that of a series of long folds, or chains, which run parallel to each other, often with great regularity. In the same part of the system the general height of the chains is sensibly equal and their summits show neither many nor deep notches. In the middle region, especially in Pennsylvania and New Jersey, they present the appearance of long and continuous walls, the blue summits of which trace along the horizon a uniform line

seldom varied by any peaks or crags. In the extreme northern and southern portions, however, this character is considerably modified. There the system loses very much of its uniformity and its physical structure becomes far more complicated; the form of simple parallel ridges almost entirely disappears.

There is one feature of the Appalachian system which distinguishes it from the ranges of the Jura; it is the well marked division into two longitudinal zones of elevation, one turned towards the shores of the Atlantic, in which the form of parallel chains just spoken of predominates, and the other turned towards the interior, which is composed of elevated and continuous plateaus, descending from the summit of their eastern escarpment, in the centre of the system, in gentle stages towards the basins of the lakes and the valley of the Ohio. Occasionally minor chains, very little elevated from their base, wrinkle the surface of the table-lands. Their parallelism with those of the eastern mountainous zone shows that they are but the last undulations due to the action of the same forces which have upheaved and folded that region, and which have raised at the same time, the mass of these more uniform plateaus. Thus when from any point we traverse the Appalachian system from the Atlantic, we encounter first a plain more and more undulated and gradually ascending to the foot of the mountains; then a mountainous zone with its ranges parallel and its valleys longitudinal; at length a third zone of uniform plateaus slightly inclined towards the northwest, and cut with deep transverse valleys.

Another feature not less conspicuous characterizes the region of corrugations properly so-called. This is a large central valley which passes through the entire system from north to south, forming, as it were, a negative axis through its entire length. This is what Mr. Rogers calls the Great Appalachian valley. At the north it is occupied by lake Champlain and the Hudson river; in Pennsylvania it bears the name of Kittatinny or Cumberland valley. In Virginia it is the Great valley; more to the south it is called the valley of East Tennessee. At the northeast and at the centre its average breadth is fifteen miles; it contracts in breadth towards the south, in Virginia, but reaches its greatest dimensions in Tennessee where it measures from fifty to sixty miles in breadth. The chain, more or less compound, which borders this great valley towards the southeast is the more continuous and extends without any great interruption from Vermont to Alabama. In Vermont it bears the name of Green Mountains, which it retains to the borders of New York; in the latter State it becomes the Highlands; in Pennsylvania, the South Mountains; In Virginia the Blue Ridge; in North Carolina and Tennessee the Iron, Smoky, and Unaka Mountains. On the northwest of the great valley between the latter and the borders of the plateau parallel there extends a middle zone of chains separated by narrow valleys, the more continuous of which is the range which bounds the central valley. This zone has a variable breadth in different parts of the system, and the number of chains which compose it is by no means uniform throughout.

Although these features are common to the Appalachian system throughout its entire length, nevertheless it may be divided from north to south into three *divisions* which present very remarkable differences of structure. Passing the eye over the physical chart which accompanies this article we at once distinguish in the longitudinal extent of the Appalachian system two principal curvatures, the one at the north from Gaspé to New York, the concavity of which is turned towards the southeast; the other at the centre, from the Hudson to New River in Virginia, with its concavity also towards the southeast; the third from New River to the southwest extremity of the system, the direction of which is nearly straight or forming a gentle curve concave towards the northwest. These three divisions, diminishing in extent, from the north to the south, are well marked; at the north, by the deep valleys of the Mohawk and the Hudson, which break through the Appalachian system to its base and across its entire breadth; at the south, by the New River whose deep valley with vertical walls also separates regions whose orographic characters present remarkable differences.

The *northern division* is much the most isolated; it is geologically the most ancient, since its upheavals appear coeval with the Silurian and Devonian epochs, and are thus much anterior to the rest of the system, which only emerged after the deposit of the carboniferous rocks which it has elevated. Four hundred feet more of water would separate all the vast territory of the northern division from the American continent. One hundred and forty feet would convert into an island all New England and the British possessions as far as Gaspé; for the bottom of the valley occupied by Lake Champlain and the Hudson does not in any part exceed this level.

I distinguish in this northern portion three physical regions; 1st, the triangular plateau of the Adirondack, with its mountain chains more or less parallel, between Lake Champlain and the St. Lawrence, Lake Ontario and the Mohawk: 2nd, New England, with the two swells of land separated by the deep valley of the Connecticut, and forming the base of the Green and White Mountains: 3rd, the northern region, with the prolongation, towards the northeast, of the same features of relief from the source of the Connecticut through Maine into Canada and New Brunswick to the promontory of Gaspé and the Bay of Chaleurs.

The *middle or central division* extends in length about 450 miles. The eastern region, or region of folded chains, at first very narrow about New York, presents towards the centre, in Pennsylvania, its greatest breadth which again diminishes towards the south. It is composed of a considerable number of chains much curved towards the west, and remarkable for their regularity, their parallelism, their abrupt acclivities, the almost complete uniformity of their summits, and their moderate elevation, both relative and absolute, which varies from 800 and 1500 to 2500 feet. The chains, however, increase in elevation towards the south, while they become more numerous and more indented. In the Peaks of Otter, in Virginia, they attain to 4000 feet.

The western region, or the region of plateaus, is quite narrow in the

southern part, but acquires towards the north the greatest breadht which it attains in any part of the Appalachian system. Its highest terraces occupy all the State of New York south of the Mohawk, and a considerable part of Pennsylvania and culminate in the plateaus in the neighborhood of Lake Erie, where the mean altitude of the plateau reaches 2000 feet, the valleys preserving a height of 1500 feet, while the hills reach 2600 feet.

This table land forms a remarkable water-shed from which the waters descend by the Susquehanna into the valley of the Chesapeake and the Atlantic Ocean, by the Genesee and St. Lawrence to the same ocean, and by the Alleghany and Ohio to the Gulf of Mexico. The Susquehanna thus starts from Lake Erie at the extreme western border of the plateau, and runs across all the Appalachian system and its mountain-ranges to its eastern base. More to the southward the eastern escarpment of the plateau divides, as far as the sources of the Potomac, the waters of the Atlantic coast from those of the Gulf of Mexico. It is the same escarpment which bears the local name of Alleghany Mountain, a name which continues to be applied, south of the waters of the Potomac, to the dividing ridge along the sources of the various branches of James River, and even to the irregular hills which form a water-shed between the waters of the Upper Roanoke and New River, across the Great Valley, near Christiansburg. Through all this middle region the name of Blue Ridge is applied to the main eastern chain which separates the Great Valley from the Atlantic slope, and which is cut by all the rivers which flow out of it.

The *southern division*, from New River to the extremity of the system, is much the most remarkable for the diversity of its physical structure and its general altitude. Even the base upon which the mountains repose is considerably elevated. Although the elevation of the Atlantic plain at the eastern base of the mountains is only 100 to 300 feet in Pennsylvania, and 500 in Virginia near James River, it is 1000 to 1200 feet in the region of the sources of the Catawba. In the interior of the mountain region the deepest valleys retain an altitude of 2000 to 2700 feet.

From the dividing line in the neighborhood of Christiansburg and the great bend of New River the orographic and hydrographic relations undergo a considerable modification. The direction of the principal parts of the system is also somewhat changed. The main chain which borders the Great Valley on the east, and which more to the north, under the name of the Blue Ridge, separates it from the Atlantic plain, gradually deviates towards the southwest. A new chain detached on the east, and curving a little more to the south, takes now the name of Blue Ridge. It is this lofty chain, the altitude of which, in its more elevated groups, attains gradually to 5000 and 5900 feet, which divides in its turn the waters running to the Atlantic from those of the Mississippi. The line of separation of the eastern and western water, which, to this point, follows either the central chain of the Alleghanies, or the western border of the table-land region, passes now suddenly to the eastern chain

upon the very border of the Atlantic plain. The reason is that the terrace which forms the base of the chains, and the slope of which usually determines the general direction of the water courses, attains here its greatest elevation, and descends gradually towards the northwest. The base of the interior chain which runs alongside the Great Valley is thus depressed to a lower level, and though the chain itself has an absolute elevation greater than that of the Blue Ridge, the rivers which descend from the summits of this last, flow to the northwest towards the great central valley which they only reach, in southern Virginia and North Carolina, by first passing across the high chain of the Unaka and Smoky mountains through gaps of 3000 or 4000 feet in depth.

This southern division thus presents from southeast to northwest three regions very distinct.

The first is the high mountainous region comprised between the Blue Ridge and the great chain of the Iron, Smoky, and Unaka mountains which separate North Carolina from Tennessee. It commences at the bifurcation of the two chains in Virginia, where it forms, at first, a valley of only ten to fifteen miles in breadth, in the southern part of which flows New River ; it then enlarges and extends across North Carolina and into Georgia, in length more than 180 miles, varying in breadth from twenty to fifty miles. The eastern chain, or Blue Ridge, the principal watershed, is composed of many fragments scarcely connected into a continuous and regular chain. Its direction frequently changes and forms many large curves. Its height is equally irregular. Some groups elevated from 5000 feet and more, are separated by long intervals of depression in which are found gaps whose height is 2200 to 3700 feet, often but little above the height of the interior valleys themselves with which they are connected. The interior, or western chain, is much more continuous, more elevated, more regular in its direction and height, and increases very uniformly from 5000 to nearly 6700 feet.

The area comprised between these two main chains, from the sources of the New River and the Watauga, in the vicinity of the Grandfather Mountain, to the southern extremity of the system, is divided by transverse chains into many basins, at the bottom of each one of which runs one of those mountain tributaries of the Tennessee, which by the abundance of their waters merit the name of the true sources of that noble river.

Between the basin of the Watauga and that of the Nolechucky rises the lofty chain of the Roan and Big Yellow mountains. The northwest branch of the Black mountain and its continuation as far as the Bald mountain separate the basin of the Nolechucky from that of the French Broad river. Between the latter and the Big Pigeon river stretches the long chain of the Pisgah and the New Found mountains. Further to the south the elevated chain of the Great Balsam mountains separates the basins of the Big Pigeon and the Tuckasegee ; next comes the chain of the Cowee mountains between the latter river and the Little Tennessee. Finally the double chain of the Nantihala and Valley River mountains separates the two great basins of the Little Tennessee and

the Hiwassee. The bottom of these basins preserves in the middle, an altitude of from 2000 to 2700 feet. The height of these transverse chains is greater than that of the Blue Ridge, for they are from 5000 to 6000 feet and upwards; and the gaps which cross them are as high, and often higher than those of the Blue Ridge. In these interior basins are also found groups, more or less isolated, like that of the Black mountains, which, with the Smoky mountains, present the most elevated points of the system.

Here then through an extent of more than 150 miles, the mean height of the valley from which the mountains rise is more than 2000 feet; the mountains which reach 6000 feet are counted by scores, and the loftiest peaks rise to 6700 feet; while at the north, in the group of the White mountains, the base is scarcely 1000 feet, the gaps 2000 feet, and Mount Washington, the only one which rises above 6000 feet, is still 400 feet below the height of the Black Dome of the Black Mountains. Here then in all respects is the culminating region of the vast Appalachian system.

It is worthy of notice that in the Appalachian, as in many other systems of mountains, the culminating points are situated, neither near the middle, nor in the neighborhood of what may be called its central axis, which is here the Great valley, but near the northern and southern extremities, and on the eastern side, almost outside of the system. These culminating regions seem almost exceptions to the normal structure of the system. The high mountainous region of North Carolina which has just been described is, from the bifurcation of the Blue Ridge near the great bend of the New River, an additional fold which attaches itself on the east along the principal chain which bounds the Great Valley, just as the swell, which runs along the east of the Connecticut River, upon which the group of the White mountains is situated, is an additional fold attaching itself to the east of the normal chain of the Green mountains.

The second region of this southern division is the continuation of the Great Central Valley which is divided by a general swell of the land about the sources of the Holston, into two distinct basins, the one in Virginia, narrower and more elevated, which in the basin of the New River, rises gradually towards the south from an elevation of 1600 feet to 2600 feet; the other in Tennessee, where the valley widens to nearly sixty miles between the Smoky mountains and the Cumberland mountains, but where it has a mean elevation of not more than about 1000 feet, that is, only one-half of the height of the neighboring valleys in the mountainous region of North Carolina.

The third region is that of the plateaus which, in Tennessee, are reduced to a table land about thirty or forty miles wide, called the Cumberland mountains on account of the abrupt edges which it presents upon the east and the west, and which give to it the appearance of a mountain chain. Further north, in Virginia, the plateaus expand and fill a vast area to the west of the Clinch and the Cumberland mountains and extend over a part of Kentucky, the central portion of which, near Lexington, preserves an altitude of more than 1000 feet.

The rapid sketch here given shows that in a hypsometrical, as well as from a geological, point of view, and even to a certain extent from its physical structure, the Appalachian system seemed to be divided into two sections of nearly equal extent; a *northern section*, which is geologically more ancient, comprehending the northern division from the mouth of the Hudson to Gaspé; and a *southern section*, which is more modern, comprising the central and southern divisions, which are bound together by more than one characteristic common to both. The separation is distinguished by a remarkable general depression of all the altitudes of the eastern zone, or parallel mountain chains, a depression which attains its lowest point in New Jersey in the parallel of New York City.

Passing from this region, where the Blue Ridge and the Kittatinny mountains are but little more than 800 or 1000 feet high, and the Great valley 50 to 150 feet, the altitude in the northern section increases rapidly, but regularly, towards the northeast, where, almost in the same parallel, lat. 44° N., we find the culminating points at Mount Washington 6288 feet high in the White Mountains, Mount Mansfield 4430 feet in the Green Mountains, and Mount Tahawus or Mount Marcy 5739 feet, in the Adirondack group. Further north the Adirondack group terminates, and the Green Mountains lose somewhat of their continuity, but show here and there, as far as Gaspé, scattered groups of mountains which still preserve an elevation of 3000 or 4000 feet.

In the southern section the altitude increases from the northeast to the southwest with the same regularity but less rapidly, and it is only towards the extremity of the system in North Carolina that they attain their maximum elevation in the Black Mountains 6700 feet, and the Smoky Mountains 6660 feet. Here, as at the north, beyond the culminating points the general altitude is but little diminished until we arrive almost to the termination of the mountains."

INQUIRIES BY THE COLONIAL OFFICE RELATIVE TO CANADIAN NATURAL HISTORY.

GOVERNOR'S SECRETARY'S OFFICE,

Quebec, Dec. 22nd, 1860.

SIR,—I am directed by His Excellency the Administrator of the Government to transmit herewith a copy of a circular despatch from His Grace the Duke of Newcastle enclosing a series of questions relative to the Natural History of the British Colonies: and I am to request you will have the goodness to furnish His Excellency for the information of the Secretary of State with such answers as you may possess the means of giving.

I have the honor to be, Sir,

Your obedient Servant,

R. T. PENNEFATHER,

Governor's Secretary.

The Secretary Natural History Society, &c., &c., &c., Montreal.

DOWNING STREET.
28th June, 1860.

SIR,—With the view of ascertaining what materials may have been collected, or what works published, descriptive of the Natural History of the British Colonies, and relative also to some other Scientific subjects, I shall feel obliged to you to furnish me with such answers as you may possess the means of giving, within your Government, to the questions contained in the enclosed paper.

In any of the colonies where Scientific Societies are constituted, it will be advisable to make use of any aid which they may be so good as to contribute towards answering these enquiries.

I have, &c.,
(Signed,) NEWCASTLE.

Governor, the Rt. Hon. Sir E. Head, Bart.

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1. Have any works been published on the Botany of the Colony, and if so state the title of each work, the name of the author, and the year of publication adding, if requisite, any remark on the esteem in which it is held?

2. The same question as to Zoology.

3. The same question as to any works or published reports on Geology.

4. Does any public botanical garden exist in the Colony, and if so, briefly state the authority under which it is superintended and funds by which supported?

5. Is there any Zoological Museum, or any collection of living animals in a Zoological Garden, or any accredited set of correct drawings of the chief animals of the Colony?

6. Is there any Geological Museum, or any well known private collection of Geological specimens or unpublished records of Geological Surveys by competent observers?

7. What are the best known records, if any, of the Meteorology of the Colony, and are they published and easily procurable?

8. Are there any well known records of the phenomena of the tides, and if so, by what observers, and at what date?

9. The same question as to magnetical phenomena.

10. Have the latitude and longitude of the principal places on the coast been determined by careful celestial observations, and if so, by what observers and at what periods?

11. The same question as to the latitude and longitude of principal places inland.

N. B.—It is requested that the answers may be sent on a separate sheet prefixing to each the number of the question in this paper.

REVIEWS AND NOTICES OF BOOKS.

Contributions to the Natural History of the United States, by LOUIS AGASSIZ. Vol, 3.

This volume is more than a worthy successor to the two previous. The author is here completely on his own ground, and dealing with a group of animals peculiarly requiring such labour as he can perform better than any other naturalist, at least on this continent.

All dwellers by the sea side or visitors thereto, know the curious "jelly fishes" that swim lazily on the calm summer sea, or are cast on the shore by the storms of autumn. Yet few know the complex structures, the strange transformations, the peculiar habits of these little masses of living jelly, so delicate that they cannot be touched without injury, and having so little solid matter in their composition, that when dried on the beach they leave a mere pellicle on the sand.

Look for instance at the great blue jelly fish—the *Cyanea Arctica* of our shores, of which in the work before us, a series of admirable portraits is given. There it floats, six inches or a foot in diameter, its flat purple disk looking like a mould of jelly cast into the sea, but slowly and regularly contracting and expanding as the creature urges its way along. Behind trails a long tassel of red tentacles, capable of benumbing and entangling in their meshes any unwary fish, crustacean or mollusk, that may come in their way, and from the blistering properties of the poisoned thread or lasso cells with which they are filled, not harmless to thin skinned bathers. In the midst of the tentacles hangs the proboscis, expanding into a multitude of complex labial processes like frills of most delicate membrane; and at the base of the proboscis are the ovaries laden with the germs of a numerous progeny. A most singular creature truly, and presenting in its minute structures peculiarities quite as wonderful as in its external form;

as for instance in the numerous radiating tubes that serve it for veins and arteries, and in the little eye specks protected by complex lids, that are placed at the margin of the disk, and are its organs of vision.

The changes which these creatures undergo in the progress of their growth, are perhaps more wonderful than any other part of their history. The egg is hatched into a minute animalcule or *planula* of oval form, and with cilia or spontaneously moving threads on its surface. This fixes itself and becomes a *scyphistoma* or hydroid polyp of sack-like form, attached by the base, and stretching forth numerous tentacles from the mouth in search of food. The polyp multiplies by gemmation or budding, so that many may originate from one egg. When full grown it subdivides transversely and becomes a *strobila*, which resembles a number of cup-like polyps stuck one into the mouth of another. The strobila eventually breaks up and its separate parts become little freely swimming umbrella-shaped medusæ, called *ephyræ*, still quite dissimilar from the parent, to whose form they at length attain in process of growth. The earlier fixed states are passed through during winter, and at the bottom of the sea; and it is evidently the intention of these remarkable transformations that these creatures shall be capable of quickly filling the summer sea with an abundant brood in each succeeding year, much to the benefit no doubt of multitudes of roving fishes which make the Acalephs their prey.

The Cyanea thus roughly sketched may be regarded as a typical Acaleph; but the class embraces a variety of other forms, which are grouped by Agassiz in three orders, (1) *Hydroidea*, (2) *Discophora*, (3) *Ctenophora*, and it is to the second of these that our Cyanea belongs.

In the first and lowest of these orders we have the hydra-like polyps, with bodies hollowed into digestive sacks open at top and furnished with prehensile tentacles. Some are solitary and naked, others protected by horny or stony cells, and often grouped by gemmation or budding in complex branching structures, some of them small and resembling sea weeds, and others hard and calcareous like the true corals; others again are specialized into separate tentacular, reproductive and digestive polyps.

To understand these differences let us suppose an animal reduced to a mere digestive sack, with or without a horny case or cell, and having tentacles at top, and the power of producing

buds which may either remain attached or become free and found new colonies. This gives us the condition of the *Hydræ* and *Tubulariæ*. Next let us suppose that by budding, such a creature founds a complex branching structure, furnished with little horny cells, in each of which resides an animal contributing its quota to the general nourishment of the whole community. This is the condition of the *Sertulariæ*, *Campanulariæ*, &c., so abundant in the ocean, and forming so large a part of the zoophytes of the older naturalists. Further, these colonies of Hydroids, conspire to produce capsules, growing like fruits on their tree-like structures, and giving birth not to young polyps, but to little medusæ like the Cyanea, but simpler in structure, and which produce the eggs destined to form new colonies of Hydroids. It is here that we perceive the connecting link between the Hydroids and the true Medusæ.

But another modification of the hydroid structure is found in nature. Let us suppose that we have taken one of the complex branching structures last mentioned, and have cut off all the tentacles of the polyps, and taken out of the cells all the digestive sacks, and placed by themselves all the reproductive buds or capsules. Let us farther suppose that we have stuck these parts separately, and still alive, upon a living animal film spread over the surface of a shell or stone, or attached to the underside of a hollow gelatinous sack floating on the sea, so as to produce a complex group of separate tentacular, digestive, and reproductive parts, we shall then have the structures of the *Hydractinia*, that clothes some of the dead shells of our cabinets with a rough, unsightly film, and of the *Physalia* or Portuguese man-of-war, that floats like a purple and orange bubble on the tropical seas. Such are the general aspects of the Hydroidea.

In the second order, the, *Discophora*, already illustrated by the example of the *Cyanea*, the animal is greatly expanded laterally into a locomotive disk, to the edges of which the tentacles are attached.

In the third order, the *Ctenophora*, the parts become fewer but more complex, and the normal form is a transparent gelatinous ball, with the digestive cavity in the centre, the mouth in front, two pulsating vessels for circulating the blood at the sides, locomotive fins arranged in bands like the ribs of a melon, two long and complicated tentacles behind, where are also the eye specks. It is the last order that is specially described and illustrated in

the present volume, in a very full and satisfactory manner. As an example of a description interesting to every reader who takes pleasure in contemplating the "creeping things innumerable" that God has made in the sea, we quote the following description of the habits of the *Pleurobrachia rhododactyla*, a little ball of living jelly very common on our coasts in summer, and about the size of a large pea.

"The Ctenophoræ differ essentially from the Discophoræ. Both their form and organs of locomotion give them a different appearance. The Discophoræ, setting aside the various modifications arising from marked peculiarities of their outline, move like an umbrella, which, by alternately opening and shutting, would make its way under water by means of such movements. It is by the contraction of the body alone, or rather by the agency of the motory cells which form the mass, that motion is produced in these animals. Not so in the Beroid Medusæ, where, besides the action of the motory cells, the whole body, more or less spherical or ovate, compact or split at one end, is kept swimming by the flapping of innumerable small paddles arranged in vertical rows, like the ribs of an orange, upon the outer surface. These rows are generally eight in number, extending from one pole of their spheroid body to the opposite, like the meridians of an artificial globe. But, owing to the inequalities in the motions of their vertical flappers, and their radiated arrangement upon the more or less spherical body, these animals have a somewhat rotatory motion, unless the paddles move on all sides with perfect steadiness and uniformity.

'There can be scarcely anything more beautiful to behold than such a living transparent sphere sailing through the water, coursing one way or another, now slowly revolving upon itself, then assuming a straight course, or retrograding, advancing or moving sideways, in all directions with equal precision and rapidity; then stopping to pause, and remaining for a time almost immovable, a slight waving of some of its vibrating organs easily counterbalancing the difference of its specific gravity and that of the water in which it lives. So Pleurobrachia may appear at times, and so does it also appear when moving in a state of contraction. But generally, when active, it hangs out a pair of most remarkable appendages, the structure and length and contractility of which are equally surprising, and exceed in wonderful adaptation all I have ever known among animal structures. Two apparently simple, irregular, and unequal threads hang out from opposite sides of the sphere. Presently these appendages may elongate, and equal in length the diameter of the sphere, or surpass it, and increase to two, three, five, ten, and twenty times the diameter of the body, and more and more; so much so that it would seem as if these threads had the power of endless extension and development. But as they lengthen they appear more complicated: from one of their sides other delicate threads shoot out like fringes, forming a row of beards like those of the most elegant ostrich

feather, and each of these threads itself elongates till it equals in length the diameter of the whole body, and bends in the most graceful curves. These two long streamers, stretching out in straight or undulating lines, sometimes parallel, then diverging or variously curving, follow the motions of the main sphere, being carried on with it in all its movements, which are no doubt influenced by them to a considerable extent. Upon considering this wonderful being, one is at a loss which most to admire, the elegance and complication of that structure, or the delicacy of the colors and hues, which, with the freshness of the morning dew upon the rose, shine from its whole surface. Like a planet round its sun, or, more exactly, like the comet with its magic tail, our little animal moves in its element as those larger bodies revolve in space, but unlike them and to our admiration, it moves freely in all directions; and nothing can be more attractive than to watch such a little living comet as it darts with its tail in undetermined ways and revolves upon itself, unfolding and bending its appendages with equal ease and elegance, at times allowing them to float for their whole length, at times shortening them in quick contractions and causing them to disappear suddenly, then dropping them as it were from its surface so that they seem to fall entirely away, till, lengthened to the utmost, they again follow in the direction of the body to which they are attached, and with which the connection that regulates their movements seems as mysterious as the changes are extraordinary and unexpected. For hours and hours I have sat before them and watched their movements, and have never been tired of admiring their graceful undulations. And though I have found contractile fibres in these thin threads, showing that these movements are of a muscular nature, it is still a unique fact in the organization of animal bodies, that parts may be elongated and contracted to such extraordinary and extensive limits by means of muscular action. And what is so surprising, is not so much the sudden and powerful contraction which brings within the compact limits of a pin's head the whole mass of these tentacles that a moment before were floating so elegantly through such a great extent in the water, as the relaxation, which takes place in an absolutely passive manner; for when watching them we are suddenly struck with astonishment on finding that the tentacle which we expected to see drop to the bottom of the jar is still in organic connection with the body from which it hangs. Plate I. of my paper in the Memoirs of the American Academy represents some few of the attitudes of our Pleurobrachia in its various movements, one of which is reproduced in this work (Pl. II^a^. *Fig.* 25); but I cannot find words to describe all the beautiful changes which the parts thus in motion assume in different attitudes. At one moment the threads, when contracted, seem nodose; next, when more elongated, these knots are stretched into the appearance of a spiral; next, the spiral, elongating, assumes the appearance of a straight or waving line. But it is especially in the successive appearances of the lateral fringes arising from the main thread that the most extraordinary diversity is displayed.

Not only are they stretched under all possible angles from the main stem, at times seeming perpendicular to it, or bent more or less in the same direction, and again as if combed into one mass; but a moment afterwards every thread seems to be curled or waving, the main thread being straight or undulating; then the shorter threads will be stretched straight for some distance and then suddenly bent at various angles upon themselves, and perhaps repeat such zigzags several times, or they may be stretched in one direction and bent at various angles in the plane of another direction; then they may be coiled up from the tip and remain hanging like pearls suspended by a delicate thread to the main stem, or like a broken whip be bent in an acute angle upon themselves with as stiff an appearance as if the whole were made up of wires; and, to complete the wonder, a part of the length of the main thread will assume one appearance and another part another, and pass from one into the other in the quickest possible succession: so that I can truly say, I have not known in the animal kingdom an organism exhibiting more sudden changes and presenting more diversified and beautiful images, the action meanwhile being produced in such a way as hardly to be understood. For, when expanded, these threads resemble rather a delicate fabric spun with the finest spider's thread, at times brought close together, combed in one direction without entangling, next stretched apart, and preserving in this evolution the most perfect parallelism among themselves, and at no time and under no circumstances confusing the fringes of the two threads: they may cross each other, they may be apparently entangled throughout their length, but let the animal suddenly contract, and all these innumerable interwoven fringes unfold, contract, and disappear, reduced as it were to one little drop of most elastic india-rubber. Week after week I have preserved these animals alive, and have never been tired of comparing again and again their changes in these thousand-fold developments of their appendages. I have called together those who felt the slightest curiosity for such objects to witness these phenomena, and have found them all interested to the utmost; and if I have anything to regret, it is not the time lost in this contemplation,—for the more I became familiar with the sight, the more was I impressed with its beauty, as I could contrast with the new forms presenting themselves before my eyes those different states with which I had been familiar before,—but the circumstance that the time was too short to trace such a connection between all the microscopic details of their structure and their functions, as would fully explain the latter; although I am aware that I have noticed many particulars which had not been observed before."

The following statements show that these creatures possess both vision and intelligence.

"Having recently seen myriads of these animals, it may not be superfluous to add, that all the various attitudes in which I have formerly seen them in confinement may be observed at one glance, when coming

suddenly upon a bank of them slowly drifting with the tide. Under these circumstances, however, they are not altogether at the mercy of the current; and it is curious to see how they resist its action by stretching their tentacles in a straight line in opposite directions and at right angles with the vertical axis of the body. I have also satisfied myself that they are aware of the approach of danger; for day after day I have seen thousands of them, which were quietly moving near the surface with the mouth wide open in search of food, suddenly turn upon themselves and with a quick jerk dive into the deep as my boat drew nearer and nearer. In fact, all Acalephs dive away from the surface when approached, and make accelerated motions to escape the net or glass dipped into the water to catch them. It seems as if they were endowed with the power of seeing, for noise has no effect upon them."

In the earlier chapters of the work much space is devoted to the classification of the Acalephs in general, and their place among the Radiates. This as held by the author may be represented by the following table, the groups being numbered from the lowest to the highest.

PROVINCE RADIATA.

Class I.	Class II.	Class III.
POLYPS.	ACALEPHS.	ECHINODERMS.
Order 1. *Actinoids.*	Order 1. *Hydroids.*	Order 1. *Crinoids.*
2. *Alcyonoids.*	2. *Discophores.*	2. *Asteroids.*
	3. *Ctenophores.*	3. *Echinoids.*

The only fairly disputable point in this table is the question, whether the Acalephs are not lower than the Polyps, a question on both sides of which much may be urged, but on which we are scarcely as yet inclined to agree with Prof. Agassiz.

One important point to geologists illustrated in this work is the affinity of the Millepore corals with the Acalephs rather than the Polyps, and the consequent probability that the orders *Tabulata* and *Rugosa*, which are the prevailing Palæozoic corals, and which have built up so many of our Silurian limestones, are also Acalephs. J. W. D.

'*The Romance of Natural History.*' By PHILIP HENRY GOSSE, F.R.S. 372 pp. demy 8vo; twelve plates. London: Nisbet & Co. Montreal: B. Dawson & Son.

(*From the Zoologist.*)

"There are more ways than one of studying Natural History.

There is Dr. Dryasdust's way; which consists of mere accuracy of defination and differentiation; statistics as harsh and dry as the skins and bones in the museum where it is studied. There is the field observer's way; the careful and consciencious accumulation and record of facts bearing on the life-history of the creatures; statistics as fresh and bright as the forest or meadow where they are gathered in the dewy morning. And there is the poet's way; who looks at nature through a glass peculiarly his own, the æsthetic aspect, which deals, not with statistics, but with emotions of the human mind,—surprise, wonder, terror, revulsion, admiration, love, desire, and so forth,—which are made energetic by the contemplation of the creatures around him.

"In my many years' wanderings through the wide field of Natural History, I have always felt towards it something of a poet's heart, though destitute of a poet's genius. As Wordsworth so beautifully says.

> To me the meanest flower that blows can give
> Thoughts that do often lie too deep for tears.'

"Now this book is an attempt to present Natural History in this æsthetic fashion. Not that I have presumed constantly to indicate—like the stage directions in a play, or the 'hear, hear!' in a speech—the actual emotion to be elicited; this would have been obtrusive and impertinent: but I have sought to paint a series of pictures, tne reflections of scenes and aspects in nature, which in my own mind awaken poetic interest, leaving them to do their proper work."—*Preface.*

In these words does Mr. Gosse herald in his new publication, which is one of the most readable and agreeable of all his readable and agreeable books. The plan, if there be a plan, is most desultory—just that touch-and-go style which will secure the attention even of the most indolent reader: thus we leap from lions to butterflies; then plunge into brine and boiling springs; ascend the blue vaults of heaven after insects, and seek flying fish in beds and shoals of swimming fish in a parlour: next we enjoy a sojourn with serpents; then wander among groves of Cacti; and then mount the dragon tree of Oratava. Afterwards we are introduced to the whale and the elephant, the mammoth tree of California and life in a drop of water: to the jackal, the wolf and gorilla; and witness a fatal encounter with bees.

I have really enjoyed this book, it is most delightful; and although the mixture of subjects strikes one as rather heterodox in

a work on Natural History, there will be found a method running through the whole that strings the diverse subjects together, producing a pleasant combination, like beads of various size and colour.

Mr. Gosse patronizes the sea serpent, and pleads for him apologetically, but gives us without any hesitation the history of that arch-myth the tsetse; I believe, whenever a competent naturalist shall investigate the subject he will find the tsetse a disease, which the ignorant aborigines have falsely attributed to an insect but this is of no moment; difference of opinion detracts nothing from merit; and I may truly say that I never read a book with more real pleasure than the 'Romance of Natural History,' and I know none that I can more cordially and unhesitatingly recommend to my subscribers. I hope to return to it again and again for amusing and instructive scraps to insert in the pages of the 'Zoologist.'

Narrative of the Canadian Red River Exploring Expedition of 1857, *and of the Assinniboine and Saskatchewan Exploring Expedition of* 1858. By H. Y. Hind, M. A., F. R. G. S. Professor, Trinity College, Toronto. Vols 2, London, Longman; Montreal, B. Dawson & Son.

These explorations were undertaken for the purpose of ascertaining the practicability of establishing an emigrant route between Lake Superior and Selkirk settlement and of acquiring some knowledge of the natural capabilities and resources of the Valleys of the Red River and the Saskatchewan.

In pursuance of these objects the author has given in these volumes a minute, clear and most readable account of the districts through which his course lay. The work is really a credit to the Province. The two volumes are profusely illustrated with beautiful and artistic views of interesting localities. This book should be in all our public libraries and be carefully studied by those who interest themselves in the prosperity and extension of the Province to the Westward. Distances, topography, natural productions, geological structure and climatal conditions of these regions are carefully noted. Intending emigrants will find the work invaluable.

Geological Gossip, or Stray Chapters on Earth and Ocean. By Professor D. T. Ansted, M.A., F.R.S., &c. London: Routledge & Co. Montreal: B. Dawson & Son.

A delightful book, both scientific and popular. It may be read

by young persons and amateurs with great pleasure and profit. The name of the author is a guarantee for the accuracy of its facts and the thorough treatment of its topics.

Coins, Medals, and Seals, Ancient and Modern; illustrated and described, with a sketch of the history of coins and coinage, instruction for young collectors, tables of comparative rarity, price lists of English and American coins, medals, and tokens, &c. Edited by W. C. Prime. New York: Harper & Brothers. Montreal: B. Dawson & Son.

Mr. Prime has done good service to the young numismatist in the preparation of this book. The engravings of coins and medals, with the descriptions of their devices and legends, appear to be from English sources, and with the exception of the American coins, medals, and tokens, have, if we mistake not, come from the hands of English engravers. It is too much the habit of Messrs. Harper to conceal the sources from which many of their works are derived, thus depriving the legitimate author of the credit which he merits. This practice cannot be too strongly reprobated by every lover of fair dealing and of sound literature. Notwithstanding this stricture we cannot withold our meed of praise for the excellent and practical way in which the editor has treated his valuable materials. No better book on this subject can be put into the hands of young persons. The historical matter and hints to young collectors will be found most useful. The book is beautifully printed, and with the exception noted reflects credit upon the publishers.

The Zoologist. No. 224, London, Van Voorst, has been received. It contains many interesting and original notices on the subjects to which its pages are devoted and is indispensable to the student of Natural History.

The Geologist. No. 37, Vol. 4, London, has also come to hand and contains excellent and highly interesting articles by Roberts, Salter & Salmon. Also, the continuation of a paper on the Fossil Flint implements by the editor, Mr. Mackie, with well executed illustrations. This Magazine happily combines the popular and the scientific elements.

The Canadian Journal. No. 31, for January, Toronto, has been received and contains original articles by Professors Chapman Croft and Hincks, and Messrs. McIlwraith & Robb, together with

well selected scientific and literary notes. Under the careful editorship of Prof. Chapman, this sister journal of western Canada continues to maintain its high standard of scientific and literary excellence.

The Academy of Natural Sciences of Philadelphia has sent us pages 325 to 360 of their *Proceedings* which are chiefly taken up with descriptions of new species of North American serpents in the Smithsonian Institution by Kennicott; and contributions to American Lepidopterology by Clemens.

The Natural History Society of Boston has also sent us pages 385 to 416 of their *Proceedings*, in which we find some valuable geological notes by Prof. Rogers to which we hope to draw attention in a future number.

The Essex Institute has sent us its *Proceedings*, Vol. II, Part 2, 1857 to 1859, the chief interest of which is the record they contain of the Field Meetings of this Society. These meetings we have long admired, and consider them most effective and pleasing means of promoting the interests of Natural Science. The *Historical Collections* of the same Institute, Vol. 2, No. 6, have also been received, and contain much curious and ancient lore.

MISCELLANEOUS.

Botanical Society of Canada, abstract of Recent Discoveries in Botany and the Chemistry of Plants. By Professor Lawson.

SEA-WEED AS A MANURE.

The attention of the English farmer has been recently called to the use of sea-weed as a manure. This material is thrown up in enormous quantities on the shores of Britain, and on the east coast of Scotland it is extensively employed to fertilize sand dunes that would otherwise be worthless. In dry sandy soils it acts in two ways; first, by directly contributing food materials to the crop, and, secondly, by the hygroscopic action of the mucilaginous tissues in maintaining a certain degree of humidity in the arid soil, a result that is no doubt aided by the presence of the sea-salt accompanying the weed. The richness of the ash of the common sea-weed in potash, soda, phosphates, and other materials

of plant growth, shows that it has a high manurial value. In Greenland specimens, the ash has been found to contain ten per cent of phosphates. The proportion of water in the recent weed is so large, however, that sea-weed cannot be profitably carried to great distances, but along the shores of the lower St. Lawrence and in other maritime provinces, where it can be readily obtained at certain seasons, its value can scarcely be overrated. The processes that have been suggested for converting the sea-weed into a paste for transport, mixing with peat ashes, &c., do not seem likely to lead to any useful result, so far as the British American provinces are concerned.

PAPER MATERIALS.

The cry for "more rags" which paper-makers raised some years ago, necessary failed to increase the supply of rags, but it served to bring materials to the paper-mill that had not been previously thought of. Hollyhock stems and straw and heather, and a hundred other substances, were tried and found suitable in various degrees. Many of these, while capable of being converted into paper, could not be profitably used in the manufacture; but several have taken their place as really important sources of paper fibre. Plants that require to be cultivated exclusively for this purpose are not likely to yield satisfactory results, and of late years, therefore, attention has been especially directed to the waste products of agriculture. In all agricultural plants woody fibre is produced to a greater or less extent, and that of the straw of cereal grains has been used for a number of years to a considerable extent. The leaves and husks of Indian Corn (*Zea Maize*) are also coming into extensive use, as appears from interesting details published by Professor Lindley in the Gardeners' Chronicle. Dr. Lindley's account of the manufacture appears to be founded upon statements that have appeared in the *Breslauer Gewerbeblatt* and the Daily Telegraph, a London paper. The following extracts will be of interest on this side of the Atlantic, where Indian Corn is produced in such enormous quantities:—

"Recent experiments have proved Indian Corn to possess not only all the qualities necessary to make a good article, but to be in many respects superior to rags. The discovery to which we allude is a complete success, and may be expected to exercise the greatest influence upon the price of paper. Indian Corn, in countries of a certain degree of temperature, can be easily cultivated to a degree more than sufficient to satisfy the utmost demands of

the paper market. Besides, as rags are likely to fall in price, owing to the extensive supply resulting from this new element, the world of writers and readers would seem to have a brighter future before it than the boldest fancy would have imagined a short time ago. This is not the first time that paper has been manufactured from the blade of Indian Corn ; but, strange to say, the art was lost, and required to be discovered anew. As early as the seventeenth century, an Indian corn paper manufactory was in full operation in the town of Rievi, in Italy, and enjoyed a world-wide reputation at the time ; but with the death of its proprietor the secret seemed to have lapsed into oblivion. Attempts subsequently made to continue the manufacture were baffled by the difficulty of removing the flint and resinous and glutinous matter contained in the blade. The recovery of the process has at last been affected and is due to the cleverness of one Her Moritz Diamant, a Jewish writing-master in Austria, and a trial of his method on a grand scale, which was made at the Imperial manufactory at Schlogelmuhle, near Glognitz (Lower Austria), has completely demonstrated the certainty of the invention. Although the machinery, arranged as it was for the manufacture of rag-paper, could not of course fully answer the requirements of Her Diamant, the results of the essay were wonderfully favourable. The article produced was of a purity of texture and whiteness of colour that left nothing to be desired ; and this is all the more valuable from the difficulty usually experienced in the removal of impurities from rags. The proprietor of the invention is Count Carl Octavio Zu Lippe Weissenfeld, and several experiments give the following results :—

'1. It is not only possible to produce every variety of paper frem the blades of Indian corn, but the product is equal and in, some respects even superior, to the article manufactured from rags.

'2. The paper requires very little size to render it fit for writing purposes, as the pulp naturally contains a large proportion of that necessary ingredient, which cau at the same time be easily eliminated if desirable.

'3. The bleaching is effected by an extraordinary rapid and facile process, and, indeed, for the common light-coloured packing paper the process becomes entirely unnecessary.

'4. The Indian corn paper possesses greater strength and tenacity than rag paper, without the drawback of brittleness so conspicuous in the common straw products.

'5. No machinery being required in the manufacture of this paper for the purpose of tearing up the raw material and reducing it to pulp, the expense, both in point of power and time, is far less than is necessary for the production of rag paper.

'Count Lippe having put himself in communication with the Austrian Government, an Imperial manufactory for Indian corn paper (*maishalm papier*, as the inventor calls it) is now in course of construction at Pesth, the capital of the greatest Indian corn growing country in Europe. Another manufactory is already in full operation in Switzerland; and preparations are being made on the coast of the Mediterranean for the production and exportation on a large scale of the pulp of this new material.'"

The ancient vegetation of North America.—The following general results are selected from an excellent article in Silliman, by Dr. J. S. Newberry:

1*st*. The flora of the Devonian and Carboniferous epochs in America, was, in all its general aspects similar to that of the Old World, which has been so fully described; most of the genera, and a larger number of species than at any subsequent period having been common to the two sides of the Atlantic. The relative number of identical species has, however, it seems to me, been somewhat overrated. In many of the species, regarded as the same in Europe and America, the American plants present prevalent or constant characters which may serve to distinguish them. These differences, though frequently remarked by writers, have not been thought to have a specific value; yet it it quite certain that they are as tangible and important as those which now separate many American and European species of recent plants and recent or fossil animals. I have a conviction that the progress of science will considerably diminish the proportion of identical species; a closer scrutiny and more extensive comparison of specimens resulting in the discovery of constant, though inconspicuous characters, which shall be ultimately conceded to be specific.

It is true, also, that in molluscous palæontology, recent geology, and botany the number of species common to the two continents has been considerably reduced of late years; a large number of American representatives of European species, at first considered identical for their striking and obvious coincidences, having, on closer study afforded constant though less conspicuous differences.

2*nd*. The Permian, Triassic and Jurassic rocks have hitherto furnished us but few species for comparison, but the material is increasing, and I have now on hand a large collection which has not yet been studied. Enough is already known to show that the great revolution which took place in Europe at the close of the Permian epoch was matched by a parallel though less sudden change in the flora of America.

Here as there the Lepidodendroid trees, the *Sigillariæ*, the *Nœggerathiæ*, the *Asterophyllitæ*, and the great variety of ferns that gave character to the Carboniferous vegetation were superseded by *Voltzia*, *Tæniopteris*, *Camptopteris* and a varied and beautiful Cycadaceous flora, in which were many species of *Zamites*, *Pterophyllum*, *Nilsonia*, *&c.*, the representatives of those of the "Age of Gymnosperms." which culminated in the Jurassic epoch of Europe.

During this great interval the generic correspondence between the floras of Europe and America was perhaps as plainly marked as during the Carboniferous age, but the relative number of identical species was apparently smaller.

3*d*. At the commencement of the Cretaceous epoch the flora of the continent was again revolutionized, and the vegetation of its temperate portions given the general aspect that it now presents.

This statement will surprise many, for the flora generally ascribed to the Chalk period is greatly different from that of the present. Unger has thus represented it, and Brongniart calls it a transition from the great Cycadaceous flora of the Jurassic period to the Angiospermous flora of the Tertiary. In Europe the Cretaceous flora was apparently more like that of the Lias and Oolite than in this country, for while the genera *Salix*, *Acer*, *Populus* *Alnus*, *Quercus*, *&c.*, were then introduced there as here, its general aspect was modified by the presence of numbers of *Cycadaceæ*, and its sub-tropical character attested by fan-palms.

We may find hereafter in other parts of the continent than those in which I have examined the Cretaceous strata, fossils which shall assimilate our flora of that period more closely to that of Europe; but as far as at present known, our plants of this age present an *ensemble* quite different. I have now some sixty or seventy species of Cretaceous plants, collected in New Jersey and in various parts of the great Cretaceous area of the interior of the continent, all of which indicate a flora very similar to that now

occupying the same region; many, perhaps most, of the genera being now represented in our forests—such as *Liriodendron Platanus*, *Acer*, *Populus*, *Salix*, *Alnus*, *Fagus*, *&c.* These specimens have been collected in localities included between the 36th and 41st paralles of latitude, but range from the 74th to the 110th longitude. Nowhere within this area have I yet detected any traces of palms or any indications of a tropical climate. At the base of the Yellow Sandstone series of New Mexico (Lower Cretaceous) I have found a varied and interesting flora, containing *Pterophyllum*, *Nilsonia*, *Camptopteris*, *&c.*, with a few Angiosperm dicotyledonous leaves. This is evidently the point of junction between the Cycadaceous flora of the Jurassic age and that of the chalk; for in the entire overlying Cretaceous strata, 4000 feet in thickness, though Angiospermous leaves are abundant those of Gymnospermous plants were no where discovered, nor any traces of palms, either leaves or stems. The sandstones of the Cretaceous series contain immense numbers of silicified trunks, but they are for the most part coniferous.

4*th.* For the glimpses have I obtained of the tertiary flora of North America I am mainly indebted to the kindness of Dr. Hayden who has spent several years in most successfully exploring the geology, botany, and zoology of the country bordering the Upper Missouri. Among his rich collections are fifty or more species of beautifully preserved fossil plants from the Miocene, which have been put into my hands for examination, and of which descriptions will be published, immediately after my return to Washington.

Not having the specimens, or my notes on them, with me, I can speak only generally of the flora they represent. I remember, however, that they include species of *Platanus*,—one of which closely resembles Unger's great *P. Hercules*, and is perhaps as large; *Populus*, *Acer*, *Castanea*, *Sapindus*, *Carpinus*, *Ulmus Diospyros*, *Quercus*, *Salix*, *Taxodium*, and others which indicate a flora in all its general aspects similar to that now occupying the Valley of the Mississippi. A few plants in the collection would seem to have required a somewhat warmer climate than that which the localities where they are found enjoy at present; but there are no palms amongst them, nor any of the tropical genera *Cinamonium*, *Sterculia*, *Dombeyopsis*, *&c.* so common in the Tertiary strata of Europe.

In the enumeration of the Miocene plants of the Pacific coast given by Mr. Lesquereux I find also evidence of a marked and in-

teresting difference of temperature during the Tertiary epoch, in different parts of the North American continent, under the same parallels of latitude. Mr. Lesquereux finds in Dr. Evans's collection of palms, *Salisburia*, *Cinamonium*, *&c.*, which indicate at least a sub-tropical climate; a flora quite unlike that from the Miocene of the Upper Missouri, although as he remarks, similar to that of the Miocene of Europe.

I am tempted to dwell for a moment no the interesting glimpses of the physical geography of our continent in geological times which these facts and others that have come under my observation afford.

1*st.* A large continental area occupied the place of the interior of North America, from the earliest Palæozoic ages.

2*d.* During the Carboniferous epoch, this land sustained a vegetation similar to that of the Coal period of Europe and Eastern America, though far less varied.

3*d.* Through theTriassic and Jurassic ages, the sediments from the land were strikingly like, in mineral character, to those of the same age in the Old World: and the flora was characterised by a preponderance of Cycadaceous plants, analogous of those of the Jurassic of Europe.

4*th.* In the Cretaceous age, the central nucleus of the continent was sufficiently extensive to furnish from its ruins arenaceous sediments that now cover more than half a million square miles. These sediments contain vast deposits of carbonaceous matter mainly derived from the land plants which covered the continent. As far south as lat. 35° these plants were for the most part Coniferous or Angiospermous, and included many genera now characteristic of temperate climates.

Through the Tertiary epoch, our continent had nearly the form and area it now has, the Tertiary deposits merely skirting its borders. The Marine Tertiaries are nearly limited to the shores of the present oceans, while the patches of strata of that age found nearer the centre of the continent are all, so far as I have observed or heard, of fresh water or estuary origin. Between the western base of the Sierra Nevada and the Mississippi there are, I believe no Tertiary beds not of this character, and the larger part of the great central plateau has never been covered with Tertiary or Drift sediments, but has, since the close of the Cretaceous epoch, been as now, dry land.

The facts which I have enumerated seem to indicate that over this ancient land the isothermal lines were curved much as now, and that during the Tertiary ages, there was perhaps as great a difference between the climate of the Pacific and Atlantic watersheds as exists at present.

Flint Implements in the Drift.—Very exciting dissensions have lately taken place among geologists in Europe, on the discovery in several places of the remains of man and his works mingled with those of extinct animals of the later tertiary period. The question is still *sub judice*, as it appears not yet certainly ascertained in most of the cases what are the age of the deposits, or whether they have not been disturbed by land floods, or by human agency. The most probable conclusion of the investigation thus far is, that the deposits containing these remains belong to a time later than the last great elevation of the land, and are the results of local debacles in river valleys, either occurring at a time when man had begun to colonize the regions in question, and certain tertiary animals were not yet wholly extinct, or in which human remains and works of art were caught up and mixed with fossils previously existing under the soil. With respect to the first of these alternatives it may be observed, that there is no improbability in the supposition that many animals of the latest tertiary period, remained until the introduction of man and perished subsequently, since we know that some animals thus ancient, as for instance, our American Musk Ox, still survive. The subject is a very interesting one and may lead to important conclusions respecting the commencement of the human period. We quote from the *Geological Journal*, a short paper by Mr. Flower, which gives a good idea of the nature of the facts as they relate to the district near Amiens which has been one of the principal seats of these discoveries.

"The implement or weapon, the subject of these observations, was found by me about a month since, when in company with Mr Prestwich and other Fellows of this Society I visited some gravel-pits near Amiens. When discovered it was imbedded in a compact mass of gravel, composed of large chalk-flints much water worn and rolled, and small chalk-pebbles. It was found lying at the depth of sixteen feet from the upper surface, and about eighteen inches from the face or outer surface of the quarry to which extent the gravel had been removed by me before I found it. The bed of gravel now in question forms the capping

or summit of a slight elevation of the chalk. A section of this pit, which Mr. Prestwich lately exhibited to the Royal Society showed that the gravel presents here a thickness of about ten feet. Above this occurs a thin bed of coarse, white, silicious sand interspersed with small rounded chalk-pebbles; and above the sand is a layer of strong loam, of a red colour, which is now extensively worked for the purpose of making bricks. The remains of the elephant horse, and deer have been occasionally found in the gravel; and we found in the sand which rests upon it an abundance of land and freshwater shells, all of recent species. No fossils of any kind were discovered by us in the brick-earth lying on the surface. At the distance of a few hundred yards from the convent of St. Acheul are the remains of an ancient Roman cemetery. A large stone tomb is here left standing on the surface, the brick-earth having been cleared away from it; and here many Roman coins and bronze ornaments are found.

At St. Roch, (about half a mile distant from St. Acheul), we also examined a quarry of flint-gravel, of precisely the same character, and apparently of the same period, as that of St. Achuel. We procured from it two very fine tusks of the *hippopotamus*, which had been found twenty feet from the surface. These were but little rolled or broken, and it seems probable therefore, that the forces that transported these flint implements to their present position may also have deposited these remains of the *hippopotamus.*

The first discovery of these flint instruments, as well in this quarrv as in other localities in the Valley of the Somme, is due to M. Boucher de Perthes, of Amiens. It was with a view to verify by personal observation the result of his researches that our visi- to St. Acheul and the neighbourhood was undertaken. Mr. Prestwich had, indeed, previously visited the spot, and had emt bodied the result of his researches in a paper which was read before the Royal Society in May last. He had not, however, succeeded in finding one of these implements *in situ*, although he had procured several of them from the labourers. It was only after labouring for several hours that I succeeded in disinterring the specimen in question.

The result of our examination perfectly satisfied us, as it had already satisfied Mr. Prestwich, of the frequent occurence of these weapons or implements beneath the beds of loam, sand, and gravel which I have described. We not only found two good spe-

cimens of these implements, but we brought away upwards of thirty others, taken from the same pit. Some of these were found at about the same depth as that which I discovered, and some about four feet lower down. They were procured without difficulty from the labourers and their children. Mr. Prestwich, on the occasion of his first visit, in company with Mr. Evans, brought away about twenty specimens; and many others are to be seen in M. Boucher de Perthes' museum. They are so common in the pit in question as to have acquired a trivial name and are known by the workpeople as *langues de chat.*

There is one peculiarity of these implements which appears to deserve particular notice ; they were evidently water-worn and rounded pebbles before they were formed into weapons, or tools; and this, indeed is just such a condition as we should expect to find. None but people destitute of iron would have been content to use such rude and uncouth instruments as these; and a people unprovided with iron would also be unable to quarry the chalk for the sake of the flint imbedded in it, but would have been forced to content themselves with those fragments which lay scattered upon the surface, or but a little below it. If we examine the specimens closely, we find that, while the manufactured or worked surfaces, (namely the cutting edges and the point) are nearly as sharp and clear as if worked yesterday, the portion left of the original, or, if we may so call it, the *natural* surface (that which has not been struck off in the course of the manufacture), is often very much water-worn ; and it also presents that peculiar discoloration, usually found in flints long exposed to the influence of the atmosphere, extending to the depth of a quarter or an eighth of an inch, and probably due to some chemical change resulting from mechanical forces.

It would thus seem that these forces, whatever they may have been, by means of which these implements were carried into their present position, were in operation but for a short period, since otherwise the sharp edges which they still retain would have been rounded and worn if not altogether obliterated; and further that the rolled and discoloured surface of the flint-pebbles with which they are associated (and from which indeed, it seems probable that they were originally taken and fashioned) was due to some former change—the drift or gravel having subsequently been merely shifted from some other spot, bearing these

implements with it, just as the loose ballast in the hold of a vessel is shifted and rolled from one side to another.

No one who attentively examines these implements can doubt hat they are the products of human skill. Rude and uncouth as they may appear, that rudeness is probably not so much due to any deficiency of intelligence in the manufacturer as to the want of iron or some other metals wherewith to work. Probably no workman who found himself destitute of metal would be able to produce from flint-pebbles more useful or elegant implements. Those who are familiar with the forms which are presented in those flints which are casually fractured, will agree that it is almost impossible that even a single flint should be so fractured by accident as to assume the shape of these implements; but here we have a great number, all taken from a single quarry. Further, it will be seen that the original or natural surface is never retained where t at all interferes with the shape and symmetry of the weapon. Whenever it would have so interfered, chiefly on the sides and at the point, it has been chipped away; and thus there has been no waste of labour, nothing having been removed but that which was inconvenient. It will also be noticed that they are all formed after a certain rude but uniform pattern; they are worked to a blunt point, at one end, with a rude cutting edge on each side, and a sort of boss at the other extremity, forming a handle or hand-hold. In order the better to form this double edge, a ridge s left running down the centre; and the edges have been formed by striking away the flint in splinters from each side, in a direction at right angles with, or a little oblique to, the axis, the base or under side being usually either flat, or but slightly convex.

The discovery of these implements under the circumstances indicated cannot fail to suggest many interesting inquiries. We should all desire to know something more concerning the persons by whom, and the purposes for which, they were fabricated,—how it happened that so many of them were brought together in so small a space, and how it is that no remains have hitherto been found of those by whom they were made and used. These, however are speculations which seem to belong to the province of archæology rather than to that of geology; and they are only now alluded to by way of suggestion that topics of such importance and interest are well deserving of the investigation of archæologists."—*Quarterly Journal of the Geological Society.*

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF DECEMBER, 1860.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	29.914	29.173	29.174	30.1	31.7	26.0	.148	.149	.115	.89	.84	.87
2	202	259	425	24.2	28.2	27.3	.111	.135	.127	.86	.85	.87
3	552	741	756	26.1	32.1	30.0	.123	.143	.155	.87	.79	.92
4	817	704	736	26.1	28.2	25.5	.115	129	.117	.83	.82	.87
5	579	498	582	23.0	27.2	21.3	.106	.111	.090	.86	.75	.78
6	558	572	674	14 1	21.5	13.8	.067	.090	.063	.81	.75	.82
7	745	819	714	18.2	20.2	12.6	.082	.075	.060	.84	.70	.80
8	479	30.050	934	14.0	34.2	13.9	.067	.094	.059	.81	.73	.75
9	30.076	29.800	30.137	15.4	30.0	17.4	.070	.136	.072	.82	.81	.76
10	29.918	504	29.400	8.8	17.5	21.1	.060	.078	.085	.86	.83	.78
11	562	079	782	20.1	15.6	8.8	.091	.061	.042	.85	.78	.73
12	514	302	476	10.4	14.6	11.6	.054	.061	.051	.78	.73	.70
13	373	635	889	9.4	9.0	· 1.0	.051	.042	.034	.78	.76	.80
14	30.203	30.346	30.510	10.0	0.0	7.5	.016	.030	.325	.60	.69	.80
15	451	411	392	— 8.1	6.0	— 3.0	.020	035	.052	.60	.61	.80
16	097	29.969	056	—11.8	13.0	16.2	.020	.054	.074	.76	.71	.83
17	259	30.265	378	6.2	9 5	2.3	.047	.080	.040	.86	.76	85
18	507	545	649	— 6.0	3.0	— 8.9	.028	.028	.024	.81	.58	.79
19	389	209	226	— 9.0	4.0	20.1	.023	.038	.091	.77	.78	.85
20	204	109	132	32.4	34.0	19 0	.175	.183	.142	.94	.90	.88
21	29.594	29.551	29.645	26.1	22.3	12.9	.123	.084	.054	.87	.71	.71
22	483	802	845	19.0	31.2	19.1	.087	.149	.087	.84	.84	.84
23	996	30.029	30.104	6 0	19.7	7.2	.043	.031	.045	.73	.77	.76
24	30.116	048	178	2.0	17.2	11.6	.034	.063	.057	.71	.67	.79
25	154	083	089	9.2	19.8	18.1	.051	.031	.088	.77	.78	.92
26	253	248	242	14.2	29.9	23.9	.067	.123	.100	.81	.77	.79
27	317	301	424	19.1	25.4	17.8	.087	.111	.072	.84	.81	.75
28	468	415	503	17.3	28.4	18.9	.074	.129	.077	.77	.82	.76
29	510	344	328	16.1	19.3	16.8	.074	.071	.070	.83	.69	.80
30	323	272	220	17.0	31.2	31.4	.078	.155	.185	.83	.89	.89
31	259	240	268	19.1	24.1	20.9	.082	.100	.088	.84	.79	.78

Day of Month.	Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	W. N. W.	W. S. W.	W. S. W.	299.04	4.0	....	1.10	Cu. Str. 10.	Snow.	Snow.
2	W.	W. by S.	W. by S.	299 30	3.0	....	1.58	" 10.	Cu. Str. 10.	Cu. Str. 10.
3	W. by S.	S. by W.	W.	248.00	3.5	....	....	" 8.	" 4.	" 10.
4	N. E. by E.	N. E. by E.	N. E. by E.	106.44	3 0	....	....	" 10.	C. C. Str. 4.	" 10.
5	N. W. by N.	S.	W. by N.	287.30	3.5	....	....	" 10.	Cu. Str. 10.	" 10.
6	W. by N.	E. S. E.	S. E. by E.	59.30	4.0	....	....	C. C. Str. 6.	" 10.	Clear.
7	N. E. by E.	N. E. by E.	S. by E.	45.40	2.5	....	Inapp.	Cu. St. 10.	C. C. Str. 4.	Cu. Str. 10.
8	N. E. by E.	S. S. W.	S. E.	35.30	2 5	....	....	" 10.	Cu. St. 4.	Clear. Zodiacal light.
9	S. S. W.	W. S. W.	W. S. W.	42.90	2.0	....	....	C. C. Str. 4.	" 2.	" Au. B. and Zod. lt.
10	N. E. by E.	N. by W.	N. E. by E.	243.50	3.5	....	3.31	Snow.	Snow.	Snow.
11	N. N. W.	W. N. W.	W. N. W.	228.31	2.5	....	0.27	"	Cu. Str. 10.	Clear.
12	S. S. W.	W. S. W.	E. S. E.	97.20	2.5	....	0.75	Cu. Str. 10.	Snow.	Cu. Str. 4.
13	W. S. W.	W.	W. S. W.	66.70	2.0	....	....	C. C. Str. 4.	C. C. Str. 2.	Clear.
14	W.	W.	W.	0.10	2.6	....	....	Clear.	Clear.	"
15	N. E. by E.	N. E. by E.	S. W. by S.	17.30	2.0	....	....	Cu. Str. 10.	"	Cu. St. 10.
16	N. E. by E.	S. S. W.	S. W. by S.	25.80	2.0	....	....	C. C. Str. 2.	C. Cum. 2.	" 10.
17	W.	S. S. W.	S. S. W.	172.50	2.0	....	....	C. Str. 8.	Clear.	C. C. Str. 2. Zodiacal light.
18	N. E. by E.	N. E. by E.	N. E. by E.	88.60	2.0	....	....	Clear.	"	Clear. Zodiacal light.
19	N. E. by E.	N. E. by E.	E. by S.	160.10	3.0	....	4.40	C. C. Str. 10.	Snow.	Cu. Str. 10.
20	E. by S.	N. E. by E.	N. E. by E.	214.20	6.0	0.714	2.18	Rain.	"	Nimb. 10.
21	W. S. W.	W. S. W.	W.	140.61	3.0	....	....	Cu. Str. 10.	Cu. Str. 10.	Clear.
22	N. E. by E.	N. E. by E.	W. by S.	113.10	4.8	....	3.20	Snow.	Snow.	Cu. Str. 10.
23	S. W.	W. S. W.	W. S. W.	88.90	2.0	....	....	Clear.	Clear.	Clear.
24	W. S. W.	W.	W.	248.40	2.0	....	....	Cu. Str. 4.	"	Cirr. Str. 4. Lunar Halo.
25	W.	S. S. W.	S. W.	243.60	2.5	....	Inapp.	C. C. Str. 10.	Snow.	Cu. Str. 10.
26	S. W.	S. W.	W. S. W.	34 50	2.5	....	Inapp.	C. C. Str. 10.	"	" 10.
27	W. S. W.	W. S. W.	W. S. W.	7.60	2.0	....	....	" 10.	Cu. Str. 10.	" 10.
28	W. S. W.	W. S. W.	S. by W.	5.80	2.0	....	....	" 10.	" 10.	Hazy.
29	N. E. by E.	N. E. by E.	N. E. by E.	60.40	2.5	....	....	" 10.	" 10.	Clear. Zodiacal light.
30	N. E. by E.	S. E. by E.	S. S. E.	102.09	4 5	....	4.80	Snow.	Snow.	Cu. Str. 10.
31	W. S. W.	W. S. W.	S. W.	257.50	4.5	....		Cu. Str. 10.	Cir. Cul. 4.	" 10.

REPORT FOR THE MONTH OF JANUARY, 1861.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	30.071	29.981	30.058	21.4	28.0	19.8	.096	.117	.081	.85	.76	.77
2	29.850	901	063	19.4	31.8	13.8	.097	.149	.057	.92	.84	.72
3	0.151	30.087	29.913	1.0	7.3	7.3	.036	.040	.045	.84	.67	.76
4	000	29.954	30.009	8.4	16.1	2.5	.064	.061	.042	.88	.73	.86
5	29.985	30.027	024	10.5	26.0	22.7	.059	.111	.095	.89	.81	.79
6	30.299	147	075	11.0	10.6	7.3	.062	.059	.045	.89	.89	.78
7	29.878	29.805	29.898	4.6	10.6	7.4	.046	.048	.051	.87	.69	.87
8	30.066	30.076	30.065	5.0	24.1	20.0	.041	.094	.081	.74	.73	.77
9	055	29.928	29.855	— 5.0	4.0	1.5	.029	.030	.081	.81	.59	.70
10	29.540	837	552	2.7	19.0	5.0	.040	.077	.032	.84	.76	.14
11	980	978	30.075	23.0	—10.6	—20.6	.004	.015	.032	.25	.55	.33
12	30.096	30.191	204	34 7	— 5.1	—17.9	002	.026	.006	.22	.70	.40
13	473	563	555	26.6	1 6	—16.9	.008	.026	.008	.37	.56	71
14	337	245	080	13.8	6.4	3.0	.018	.049	.015	.74	.87	.72
15	077	29.940	040	7.0	21.7	20.0	.045	.090	.036	.76	.78	.84
16	29.891	614	29.552	22.3	24 2	14 8	.101	.085	.082	.86	.79	.87
17	759	959	30.107	16.0	17.0	5.0	.074	.078	.078	.83	.83	.74
18	30.130	30.080	29.750	— 2.0	6.8	8.7	.030	.043	.041	.80	.75	.79
19	29.600	29.550	728	12.2	18.9	15.3	.063	.077	.052	.81	.76	.82
20	680	674	816	13.1	19.9	10.0	.063	.077	.070	.81	.76	.68
21	900	958	30.084	5.1	14 7	11.1	.041	.061	.045	.74	.73	.79
22	30.317	30.350	526	4.3	17.4	5.0	.036	.072	.057	.73	.76	.73
23	620	626	687	—16.1	9.6	— 4.6	.009	.045	.038	.43	.68	.82
24	416	160	29.873	— 8.4	6 3	24.1	.056	.040	.029	.79	.70	.86
25	29.650	29.830	912	21.4	22.1	20.1	.085	.084	.111	.78	.71	.72
26	30.090	30.050	30.167	19.0	29.8	20.4	.087	.142	.074	.84	.88	.85
27	29.999	29.920	29.810	16.0	30.6	24.6	.074	.130	.091	.83	.78	.80
28	760	840	671	22.1	26.2	19.1	.090	.105	.105	.78	.73	.84
29	510	517	761	21.1	23 1	19.0	.036	.084	.087	.84	.71	.84
30	857	872	879	8.7	16.8	18.4	.042	.068	.082	.86	.75	.82
31	884	920	930	14.7	21.0	18.1	.061	.080	.052	.75	.71	.84

Day of Month.	Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	S. W.	W. S. W.	N. by E.	168.30	6.0	....	0.70	Snow.	Cu. Str. 6.	Fog.
2	S. W.	N. W.	N. E.	228.90	4.0	....	....	Cu. Str. 10.	Str. 10.	Cu. Str. 10.
3	N. E. by E.	N. E. by E.	N. N. E.	286.20	3.0	....	0.50	" 10.	Cu. Str. 10.	" 10.
4	W. S. W.	W. S. W.	W. S. W.	97.20	3.5	....	....	" 10.	Clear.	Clear. Zod. light, aurora borealis
5	S. by W.	W. S. W.	W. by S.	184.40	2.0	....	....	" 10.	Cu. Str. 10.	Cu. Str. 10.
6	W.	W. N. W.	W. N. W.	136.50	5.0	....	0.57	C. C. Str. 9.	" 10.	" 10.
7	N. E. by E.	N. E. by E.	N. E. by E.	446.60	3.0	0.100	1.10	Cu. Str. 10.	Snow.	Rain and Sleet.
8	N.	W. S. W.	W. S. W.	199.60	3.5	....	....	" 10.	C. C. Str. 4.	C. C. Str. 4.
9	N. by W.	N. E. by E.	N. E. by E.	82.90	5.0	....	....	" 10.	Cu. Str. 2.	Cu. Str. 10.
10	N. by E.	W.	W.	239.20	3.6	....	0.75	" 10.	Snow.	Clear. Zod. light, aurora borealis.
11	W.	W. S. W.	S. W. by S.	245.60	3 0	....	....	Clear.	Clear.	" " "
12	W.	S. S. W.	S. S. W.	27.20	2.0	....	....	"	"	" " "
13	S. E. by E.	S. W. by S.	S. S E.	17.20	2.0	....	....	"	"	" " "
14	N. E. by E.	S.	N. E. by E.	74.70	3.0	....	....	Cu. Str. 10.	Cu. Str. 4.	Cu. Str. 10.
15	N. E. by E.	N. E. by E.	N. by E.	169.90	5.0	....	....	" 10.	" 10.	" 8.
16	N. E. by E.	N. by E.	N. E. by E.	363.90	5.5	....	5.46	" 10.	Snow.	Snow.
17	N. E. by E.	N. E. by E.	N. E. by E.	164 70	6.5	....	....	" 10.	Clear.	Clear. Zodiacal Light.
18	N. E. by E.	N. by E.	N. E. by E.	139.20	4 0	....	....	Clear.	Cu. Str. 10.	Cu. Str. 10.
19	N. E. by E.	N. E. by E.	N. E. by E.	998.10	5 5	....	11.15	Snow.	Snow.	Snow.
20	W. S. W.	W. N. W.	W. S. W.	103.20	6.0	....	....	Clear.	Clear.	Cu. Str. 10.
21	W. by S.	W.	W.	372.80	2.5	....	....	Cu. Str. 4.	Cu. Str. 10.	" 10.
22	W.	W. S. W.	W. S. W.	674.40	2.0	....	....	C. C. Str. 6.	Clear.	Clear.
23	W. by S.	S. by W.	S.	111.90	2.0	....	....	Clear.	"	"
24	N. E. by E.	N. E. by E.	S. E. by E.	65.40	4.5	....	6.40	Cu. Str. 4.	Snow.	Snow.
25	W. S. W.	S. W.	W. S. W.	90.60	5.5	....	2.15	Clear.	C. C. Str. 8.	Cu. Str. 10.
26	S. S. W.	S. W.	S. by E.	92.10	5.0	....	....	Cu. Str. 4.	Cu. Str. 10.	" 10.
27	S. E. by E.	W. by S.	W. by S.	7.10	0.0	....	....	" 10.	" 10.	" 10.
28	S. S. E.	W. S. W.	W. S. W.	103.10	5.0	....	1.00	" 4.	Soow.	Snow.
29	W. S. W.	W. S. W.	S. W.	379.40	2.5	....	1.10	Cu. Str. 10.	Cu. Str. 10.	Cu. Str. 10.
30	W.	W. S. W.	W. S. W.	346.40	2.0	....	....	C. C. Str. 8.	" 10.	" 10.
31	W. S. W.	W. S. W.	W. S. W.	69.50	2.0	....	....	Cu. Str. 10.	" 10.	" 4.

REMARKS FOR DECEMBER, 1860.

Barometer...... Highest, the 18th day, 30·649 inches.
Lowest, the 1st day, 29.173 "
Monthly Mean, 29.918 "
" Range, 1.476 "

Thermometer... Highest, the 20th day, 34°0.
Lowest, the 14th day, 13°0.
Monthly Mean, 18°18.
Monthly Range, 47°0.

Greatest intensity of the Sun's rays, 61°7.
Lowest point of Terrestrial radiation,—14°1.
Mean of Humidity, .786.

Rain fell on 1 day, amounting to 0.714 of an inch; it was raining 14 hours and 10 minutes.

Snow fell on 12 days, amounting to 21·56 inches; it was snowing 84 hours and 54 minutes.

Most prevalent wind, the W.

Least prevalent wind, the S.

Aurora Borealis visible on 1 night.

Lunar Halo visible on 1 night.

Zodiacal Light bright.

The Electrical state of the Atmosphere has indicated moderate intensity.

REMARKS FOR JANUARY, 1861.

Barometer. ...... Highest, the 23rd day, 30.687 inches.
Lowest, the 10th day, 29.357 "
Monthly Mean, 29.983 "
Monthly Range, 1·350 "

Thermometer. Highest, the 2nd day, 31°8.
Lowest, the 12th day,—34°7.
Monthly Mean, 10°43.
Monthly Range, 66°5.

Greatest intensity of the Sun's rays, 33°4.
Lowest point of terrestrial radiation, 36°0.
Mean of humidity, .752.

Rain fell on 1 day, amounting to 0.100 of an inch; it was raining 4 hours 10 minutes.

Snow fell on 11 days, amounting to 31.68 inches, it was snowing 69 hours and 30 minutes.

Most prevalent wind, the N. by E.

Least prevalent wind, the N.

Most windy day, the 19th day; mean miles per hour, 43.08.

Least windy day, the 27th day; mean miles per hour, 0.29.

Zodiacal light very bright, and well defined.

Aurora Borealis visible on 2 nights.

The Electrical state of the Atmosphere has indicated constant and moderate intensity.

[illegible]

THE

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ARTICLE VI.—*On some points in American Geology.* By T. STERRY HUNT, F.R.S., of the Geological Survey of Canada.

(From the American Journal of Science No. 93, 1861.)

The recent publication of two important volumes on American geology seems to afford a fitting occasion for reviewing some questions connected with the progress of geological science, and with the history of the older rock formations of North America. The first of these works is the third volume of the Palæontology of New York by James Hall; we shall not attempt the task of noticing the continuation of this author's labors in the study of organic remains, labors which have by common consent placed him at the head of American palæontologists, but we have to call attention to the introduction to this 3rd volume, where in about a hundred pages Mr. Hall gives us a clear and admirable summary of the principal facts in the geology of the United States and Canada, followed by some theoretical notions on the formation of mountain chains, metamorphism and volcanic phenomena, where these questions are discussed from a point of view which we conceive to be of the greatest importance for the future of geological science. A publication of this introduction in a separate form, with some additions, would we think be most acceptable to the scientific public.

The other work before us is Prof. H. D. Rogers' elaborate report on the geology of Pennsylvania, giving the results of the Survey of that State for many years carried on under his direction, and embracing a minute description of those grand exhibitions of structural geology, which have rendered that State classic ground for the student. The volumes are copiously illustrated with maps, sections and figures of organic remains, and the admirable studies on the coal fields of Pennsylvania and Great Britain add much to its value.

The oldest series of rocks known in America is that which has been investigated by the officers of the Geological Survey of Canada, and by them designated the Laurentian system. It is now several years since we suggested that these rocks are the equivalents of the oldest crystalline strata of western Scotland and Scandinavia.* This identity has since been established by Sir R. I. Murchison in his late remarkable researches in the north-western Highlands, and he has adopted the name of the Laurentian system for these ancient rocks of Ross, Sutherland, and the Western Islands, which he at first called fundamental gneiss.† These are undoubtedly the oldest known strata of the earth's crust, and therefore offer peculiar interest to the geologist. As displayed in the Laurentide and Adirondack mountains, they exhibit a volume which has been estimated by Sir William Logan to be equal to the whole palæozoic series of North America in its greatest development. The Laurentian series consists of gneiss, generally granitoid, with great beds of quartzite, sometimes conglomerate, and three or more limestone formations, (one 1000 feet in thickness) associated with dolomites, serpentines, plumbago, and iron ores. In the upper portion of the series an extensive formation of rocks, consisting chiefly of basic feldspars without quartz and with more or less pyroxene, is met with. The peculiar characters of these latter strata, not less than the absence of argillites and talcose and chloritic schists, conjoined with various other mineralogical characteristics seem to distinguish the Laurentian series throughout its whole extent, so far as yet studied, from any other system of crystalline strata. It appears not improbable that future researches will enable us to divide this series of rocks into two or more distinct systems.

* Esquisse Géologique du Canada, 1855, p. 17.

† Quar. Journal Geol. Society, vol. xv, 353 ; xv. ; 215.

Overlying the Laurentian series on Lake Huron and Superior, we have the Huronian system, about 10,000 feet in thickness, and consisting to a great extent of quartzites, often conglomerate, with limestones, peculiar slaty rocks, and great beds of diorite, which we are disposed to regard as altered sediments. These constitute the lower copper-bearing rocks of the lake region, and the immense beds of iron ore at Marquette and other places on the south shore of Lake Superior have lately been found by Mr. Murray to belong to this series, which is entirely wanting along the farther eastern outcrop of the Laurentian system. This Huronian series appears to be the equivalent of the Cambrian sandstones and conglomerates described by Murchison, which form mountain masses along the western coast of Scotland, where they repose in detached portions upon the Laurentian series.

Besides these systems of crystalline rocks, the latter of which is local and restricted in its distribution, we have along the great Appalachian chain, from Georgia to the Gulf of St. Lawrence, a third series of crystalline strata, which form the gneissoid and mica slate series of most American geologists, the hypozoic group of Prof. Rogers, consisting of feldspathic gneiss, with quartzites, argillites, micaceous, epidotic, chloritic, talcose and specular schists, accompanied with steatite, diorites and chromiferous ophiolites. This group of strata has been recognized by Safford in Tennessee, by Rogers in Pennsylvania, and by most of the New England geologists as forming the base of Appalachian system, while Sir William Logan, Mr. Hall, and the present writer have for many years maintained that they are really altered palæozoic sediments, and superior to the lowest fossiliferous strata of the Silurian series. Sir William Logan has shown that the gneissoid ranges in Eastern Canada have the form of synclinals, and are underlaid by shales which exhibit fossils in their prolongation, while his sections leave no doubt that these ranges of gneiss, with micaceous, chloritic, talcose and specular schists, epidosites, quartzites, diorites and ophiolites, are really the altered sediments of the Quebec group, which is a lower member of the Silurian series, corresponding to the Calciferous and Chazy formations of New York, or to the Primal and Auroral series of Pennsylvania. Prof. Rogers indeed admits that these are in some parts of Pennsylvania metamorphosed into feldspathic, micaceous and talcose rocks, which it is extremely difficult to distinguish from the hypozoic gneiss, which latter, however, he conceives to present a want of conformity with the palæozoic strata.

To this notion of the existence of two groups of crystalline rocks similar in lithological character but different in age, we have to object that the hypozoic gneiss is identical with the Green Mountain gneiss, not only in lithological character, but in the presence of certain rare metals, such as chrome, titanium, and nickel which characterise its magnesian rocks; all of these we have shown to be present in the unaltered sediments of the Quebec group, with which Sir William Logan has identified the gneiss formation in question. Besides which the lithological and chemical characters of the Appalachian gneiss are so totally distinct from the crystalline strata of the Laurentian system, with which Prof. Rogers would seem to identify them, that no one who has studied the two can for a moment confound them. Prof. Rogers is therefore obliged to assume a new series of crystalline rocks, distinct from both the Laurentian and Huronian systems, but indistinguishable from the altered palæozoic series, or else to admit that the whole of his gneissic series in Pennsylvania is, like the corresponding rocks in Canada, of palæozoie age.* We believe that nature never repeats herself without a difference, and that certain variations in the chemical and mineralogical constitution of sediments mark successive epochs so clearly that it would be impossible to suppose the formation in adjacent regions of a series of crystalline schists like those of the Alleghanies contemporaneous with the sediments which produced the Laurentian system. We have elsewhere indicated the general principles upon which is based this notion of

* Dr. Bigsby in 1824 described an extensive tract of gneissoid rocks on Rainy Lake and Lake Lacroix, north of Lake Superior. The general course of the strata he states to be "from N. W. to N. by W., with a corresponding easterly dip;" but he elsewhere speaks of the gneiss as running (dipping ?) E. N. E. This gneiss often contains beds and disseminated grains of hornblende, and passes in some places into micaceous, chloritic and greenstone slates, and syenite. Staurotide is abundant in the mica schists, and octahedral iron occurs in the chloritic slates. A porphyritic granite containing beryl is also met with in this region. This gneiss is regarded by Dr. Bigsby as belonging "to transition rocks, from its constant proximity to red sandstone, the oldest organic limestone, and trap." (Am. Jour. Sci, (1) viii, 61). The lithological and mineral characters of these crystalline strata seem to be distinct from those of the Laurentian system, and to resemble those of the Appalachians. Too much praise cannot be ascribed to Dr. Bigsby for his early and extensive observations on the geognosy and mineralogy of British North America.

a progressive change in the composition of sediments, and shown how the gradual removal of alkalies from aluminous rocks has led to the formation of argillites, chloritic and epidotic rocks, at the some time removing carbonic acid from the atmosphere, while the resulting carbonate of soda by decomposing the calcareous and magnesian salts of the ocean, furnished the carbonates for the formation of limestones and dolomites, at the same time generating sea salt.*

Closely connected with these chemical questions is that of the commencement of life on the earth. The recognition beneath the Silurian and Huronian rocks of 40,000 feet of sediments analogous to those of more recent times, carries far back into the past the evidence of the existence of physical and chemical conditions, similar to those of more recent periods. But these highly altered strata exclude, for the most part, organic forms, and it is only by applying to their study the same chemical principles which we now find in operation that we are led to suppose the existence of organic life during the Laurentian period. The great processes of deoxydation in nature are dependent upon organization; plants by solar force convert water and carbonic acid into hydrocarbonaceous substances, from whence bitumens, coal, anthracite and plumbago, and it is the action of organic matter which reduces sulphates, giving rise to metallic sulphurets and sulphur. In like manner it is by the action of dissolved organic matters that oxyd of iron is partially reduced and dissolved from great masses of sediments, to be subsequently accumulated in beds of iron ore. We see in the Laurentian series beds and veins of metallic sulphurets, precisely as in more recent formations, and the extensive beds of iron ore hundreds of feet thick which abound in that ancient system, correspond not only to great volumes of strata deprived of that metal, but as we may suppose, to organic matters, which but for the then greater diffusion of iron oxyd in conditions favourable for their oxydation, might have formed deposits of mineral carbon far more extensive than those beds of plumbago which we actually meet with in the Laurentian strata.

All these conditions lead us then to conclude to the existence of an abundant vegetation during the Laurentian period, nor are there wanting evidences of animal life in these oldest strata. Sir William Logan has described forms occuring in the Laurentian

* Am. Journal of Science (2) xxv. 102, 445. xxx. 133; Quar. Journal Geol. Soc. xv. 488, and Can. Naturalist, December 1859.

detected by him in specimens from the sandstones of Wisconsin with *Dikellocephalus*, which genus has there been found to pass upwards into the magnesian limestones. On the other hand, the sandstones of Bastard in Canada, having the characters of the Potsdam, contain *Lingula acuminata* and *Ophileta compacta*, species regarded as characteristic of the Calciferous, together with two undescribed species of *Orthoceras*, and in another locality a *Pleurotomaria* resembling *P. Laurentina*. The researches of Mr. Billings have extended the fauna of the Calciferous in Canada to forty-one species, and the succeeding Chazy formation to 129 species. The thickness of this latter division in the St. Lawrence valley is about 250 feet, and it includes in its lower part about fifty feet of sandstones with green fucoidal shales and a bed of conglomerate. The Calciferous has a thickness of about 300 feet, while the Potsdam may be estimated at not far from 600 feet.

We have then seen that along the north-eastern outcrop of the great American basin in Canada and New York, the base of the palæozoic series is represented by less than 1000 feet of sandstones and dolomites, reposing directly upon the Laurentian system. A very different condition of things is, however, found in the more central parts of the basin. According to Prof. Rogers, the older Primal slates, which form the base of the palæozoic system, attain in Virginia a thickness of 1200 feet, and are succeeded by 300 feet of Primal sandstone marked by *Scolithus*, which he considers the Potsdam, followed by the upper Primal slates, consisting of 700 feet of greenish and brownish talco-argillaceous shales with fucoids. To these succeed his Auroral division, consisting of sixty feet or more of calcareous sandstone, the supposed equivalent of the Calciferous sandrock, followed by the Auroral limestone, which is magnesian, and often argillaceous and cherty in the upper beds. Its thickness is estimated at from 2500 to 5500 feet, and it is supposed by Rogers to include the Chazy and Black River limestones, while the succeeding Matinal division exhibits first, from 300 to 550 feet of limestone, (Trenton), secondly, 300 to 400 feet black shale, (Utica), and thirdly, 1200 feet of shales with red slates and conglomerates, (Hudson River group), thus completing the Lower Silurian series.

In Eastern Tennessee, Mr. Safford describes, (1st.) on the confines of North Carolina, a great volume of gneissoid and micaceous rocks similar to those of Pennsylvania, succeeded to the

west by (2nd.) the Ococee conglomerates and sandstones, with argillites, chloritic, talcose and micaceous slates, and occasional bands of limestone, all dipping, like the rocks of the 1st division, to the S. E. In the 3rd place we have the Chilhowee sandstones and shales, several thousand feet in thickness, including near the summit beds of sandstone with *Scolithus*, and considered by Mr. Safford the equivalent of the Potsdam. (4th.) The Magnesian limestone and shale group, also several thousand feet thick, and divided into three parts; first, a series of fucoidal sandstones approaching to slates and including bands of magnesian limestone; second, a group of many hundred feet of soft brownish, greenish, and buff shales, with beds of blue oolitic limestone, which as well as the shales, contain trilobites. Passing upward these limestones become interstratified with the third sub-division, consisting of heavy bedded magnesian limestone, more or less sparry and cherty near the summit. The limestones of Knoxville belong to this group, which with the 3rd or Chilhowee group is designated by Mr. Safford as Cambrian, corresponding to the Primal and Auroral of Rogers, or to the Potsdam and Calciferous sandrock, with the possible addition of the Chazy, being equivalent to the great Magnesian limestone series of Prof. Swallow in Missouri. To these strata succeed Safford's 5th formation, consisting of limestones, the equivalents of the Black River, Trenton and higher portions of the Lower Silurian.

In Eastern Canada we find a group of strata similar to those described by Rogers and Safford, and distinguished by Sir William Logan as the Quebec group. It has for its base a series of black and blue shales, often yielding roofing slates, succeeded by grey sandstone and great beds of conglomerate, with dolomites and pure limestones, often concretionary and having the character of travertines. These are associated with beds of fossiliferous limestones, and with slates containing compound graptolites, and are followed by a great thickness of red and green shales, often magnesian, and overlaid by 2000 feet of green and red sandstone, known as the Sillery sandstone, the whole from the base of the conglomerate, having a thickness about 7000 feet. These red and green shales resemble closely those at the top of the Hudson River group, and the succeeding sandstones are so much like those of the Oneida and Medina formations, that the Quebec group was for a long time regarded as belonging to the summit of the Lower Silurian series, the more so as by a great break and upthrow to

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the S. E., the rocks of this group are made to overlap the Hudson River formation. " Sometimes it may overlie the overturned Utica formation, and in Vermont, points of the overturned Trenton appear occasionally to emerge from beneath the overlap."* This great dislocation is traceable in a gently curving line from near Lake Champlain to Quebec, passing just north of the fortress; thence it traverses the island of Orleans, leaving a band of higher strata on the northern part of the island, and after passing under the waters of the Gulf, again appears on the main land about eighty miles from the extremity of Gaspé, where on the north side of the break, we have as in the island of Orleans, a band of Utica or Hudson River strata. To the south and east of this line the rocks of the Quebec group are arranged in long, narrow, parallel, synclinal forms, with many overturn dips. These synclinals are separated by dark gray and black shales, with limestones, hitherto regarded as of Hudson River age, but which are perhaps the deep-sea equivalent of the Potsdam.

The presence of conglomerates and sandstones, alternating with great masses of fine shales, indicates a period of frequent disturbances, with elevations and depressions of the ocean's bottom,while the deposits of dolomite, magnesite, travertine and highly metalliferous strata show the existence of shallow water, lagoons and springs over a great area and for a long period between the formation of the upper and lower shales. We may suppose that while the Potsdam sandstone was being deposited along the shores of the great palæozoic ocean, the lower black shales were accumulating in the deeper waters, after which an elevation took place, and the magnesian strata were deposited, followed by a subsidence during the period of the upper shales and Sillery sandstones.

Associated with the magnesian strata at Point Levis and in several other localities in the same horizon of the Quebec group, an extensive fauna is found, of which 137 species are now known, embracing more than forty new species of graptolites, which have been described by Mr. James Hall in the report of the Geological Survey of Canada for 1857, and thirty-six species of trilobites described by Mr. Billings in the Canadian Naturalist for August 1860. These species are as yet distinct from anything found in the Potsdam below or the Birdseye and Black River above;

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* See Sir William Logan's letter to Mr. Barrande, Canadian Naturalist for Jan. 1861, and Am. Journal. of Science (2) xxxi. 216.

although the trilobites recall by their aspect those found by Owen in the Lower Sandstone of the Mississippi. Seven species alone out of this fauna have been identified with those known in other formations, and of these one is Chazy, while six belong to the Calciferous, to which latter horizon Mr. Billings considers the Quebec group to belong. The Chazy has not yet been identified in this region, unless indeed it be represented in some of the upper portions of the Quebec group. The Calciferous sand-rock is wanting along the north side of the St. Lawrence valley from near Lake St. Peter to the Mingan Islands, but at Lorette behind Quebec, at the foot of the Laurentides, the Birdseye limestone is found reposing conformably upon the Potsdam sandstone.

It is not easy to find the exact horizon of the Potsdam sandstone among the black shales which underlie the Quebec group. The *Scolithus* of Rogers' Primal sandstone, and of the summit of Safford's 3rd or Chilhowee formation is identical with that found in the quartz rock at the western base of the Green Mts, and figured by Mr. Hall in the 1st volume of the Palæontology. It is however distinct from what has been called *Scolithus* in the Potsdam of Canada. The value of this fossil as a means of identification is diminished by the fact that similar marks are found in sandstones of very different ages. Thus a *Scolithus* very like that of the St. Lawrence valley occurs in the sandstone of Lake Superior and in the Medina sandstone, while in Western Scotland, according to Mr. Salter, the two quartzite formations above and below the Lower Silurian limestones of Chazy age are alike characterized by these tubular markings, which are regarded by him as produced by annelids or sea-worms. We find however in shales which underlie the Quebec group at Georgia in Vermont, trilobites which were described by Mr. Hall in 1859 as belonging to the genus *Olenus*, a recognized primordial type; he has since erected them into a new genus. Again at Braintree in Eastern Massachusetts occur the well known *Paradoxides* in an argillaceous slate. These latter fossils Mr. Hall suggests probably belong to the same horizon as certain slaty beds in the Potsdam sandstone, or perhaps even at the base of this formation. (Introduction, page 9.) In this connection we must recall the similar shales of Newfoundland,in which Salter has recognized trilobites of the same genus. These shales containing *Paradoxides*, like those underlying the Quebec group, thus appear to belong to the so-called Primordial zone, and are to be regarded as the equivalents of the Potsdam

sandstone, which both on Lake Champlain and in the Mississippi valley is characterized by primordial types. The intermingling of Potsdam and Calciferous forms to which we have already alluded, seems however to show that it will be difficult to draw any well defined zoological horizon between the different portions of these lower rocks, which at the same time offer as yet no evidences of any fauna lower than that of the Potsdam. So that we regard the whole Quebec group with its underlying Primordial shales as the greatly developed representative of the Potsdam and Calciferous (with perhaps the Chazy), and the true base of the Silurian system.

The Quebec group with its underlying shales is no other than the Taconic system of Emmons. Distinct in their lithological characters from the Potsdam and Calciferous formations as developed on Lake Champlain, Mr. Emmons was led to regard these strata as belonging to a lower or sub-Silurian group. We have however shown that the palæontological evidence afforded by this formation gives no support to such a view. To Mr. Emmons is however undoubtedly due the merit of having for a long time maintained that the Taconic hills are composed of strata inferior to the Trenton limestones, brought up into their present position by a great dislocation, with an upthrow on the eastern side. We would not object to the term Taconic if used as indicating a subdivision of the Lower Silurian series, but as the name of a distinct and sub-Silurian system it can no longer be maintained. The Quebec group evidently increases in thickness as we proceed towards the south, and the calcareous parts of the formation are more developed. In 1859, I visited in company with Mr. A. D. Hager the marble quarries of Rutland and Dorset, in Vermont. The latter occur in a remarkable synclinal mountain of nearly horizontal strata of marble and dolomite, capped by shales, and attaining a height of 2700 feet above the railway station at its base. I then identified these marbles with the limestones of the Quebec group, considering them to be beds of chemically precipitated carbonate of lime or travertine, and not limestones of organic origin.

The existence of great dislocations in the Appalachian chain is amply illustrated in the sections of Prof. Rogers, and in those given by Safford in Eastern Tennessee, where by the aid of fossils it becomes comparatively easy to trace them. See the Map accompanying his *Geological Reconnaissance of Tennessee*, 1855 ; where the magnesian limestones of formation IV, are shown to be not

only brought up on the east against the Upper Silurian and Devonian, but even to overlap the black shales at the base of the Carboniferous system. It is remarkable to find that as early as 1822, the idea of a great dislocation of this nature in Eastern New York was maintained by Mr. D. H. Barnes in his description of Canaan Mountain. [Am. Journal of Science, (1) v. pp. 15–18.]

To the southeast of this great fault in Canada we have as yet no evidence of Lower Silurian strata higher than those of the Quebec group. At the eastern base of the Green Mts. we find limestones of upper Silurian and Devonian age reposing unconformably upon the altered strata of the Quebec group, themselves also having undergone more or less alteration. Immediately succeeding are the chiastolite and mica slates of Lake St. Francis, which as we have long since stated are probably also of Upper Silurian age.

The White Mountains as we suggested in 1849, (Am.Jour.Sci. (2) ix. 19) are probably, in part at least, of Devonian age, and are the representatives of the 7000 feet of Devonian sandstone observed by Sir William Logan in Gaspé. Mr. J. P. Lesley has more recently, after an examination of the White Mts. shown that they possess a synclinal structure, and has adduced many reasons for regarding them as of Devonian age. (Amer. Mining Journal, January 1861, p. 99.

It will be seen from what has been previously said that we look upon the 1st and 2nd divisions described by Mr. Safford in Eastern Tennessee, as corresponding to the hypozoic series of Rogers and to the Green Mountain gneissic formation, which instead of being beneath the Silurian series, is really a portion of the Quebec group more or less metamorphosed, so that we recognize nothing in New England or south-eastern Canada lower than the Silurian system, nor do we at present see any evidence of older strata, such as Laurentian or Huronian, in any part of the Appalachian chain. The general conclusions which we have previously expressed with regard to the lithological, chemical and mineral relations of the Green Mts. rocks remain unchanged. [Am. Journal of Science (2) ix. 12.]

The remarkable parallelism between the rocks of Western Scotland and Canada has already been shown in the existence of the Laurentian, and Cambrian (Huronian) systems, overlaid by quartzites containing *Scolithus*, to which succeed limestones containing a numerous fauna, identified by Mr. Salter with that of the Chazy

limestone. These strata, with an eastward dip, are covered by other quartzites and limestones, to which succeeds the great gneissoid formation of the western Highlands, consisting of feldspathic, chloritic, micaceous, and talcose schists resembling closely the gneissoid rocks of the Green Mts. and including the chromiferous ophiolites of Perthshire, Banff and the Shetland Isles.

This gneissoid series was by Prof. Nicol suggested to be the older or Laurentian gneiss brought up by a dislocation on the east of the Silurian limestones, but Sir Roderick Murchison, with Messrs. Ramsay and Harkness, has shown not only from the differences in lithological character, but from actual sections, that the eastern gneissoid series is made up of altered strata newer than the Silurian limestones.* Thus in geological structure and age, not less than in lithological and mineralogical characters, the rocks of the western Highlands are the counterparts of the Laurentian and Silurian gneiss formations, as seen in the Laurentides and Adirondacks, and in the Green Mts. The same parallelism may be extended to Scandinavia, (where Kjerulf and Forbes have shown much of the crystalline gneiss to be of Silurian age,) marking as it would seem the outer edge of a vast Silurian basin, which may be followed in the other direction across the Atlantic to the Gulf of Mexico. We also remark in Great Britain as in America, that whereas the northern outcrop of the palæozoic basin offers at its base only a series of quartzose sandstones reposing upon the Laurentian system and characterized by fucoids and *Scolithus*, we find further south in England an immense development of shales, sandstones and conglomerates, which form the base of the Silurian system and correspond to the Primordial zone and the Quebec group.

We have said that upon Lake Huron and Superior the sandstones of the upper copper-bearing rocks are the equivalents of the Quebec group. The clear exposition of the question by Mr. J. D. Whitney in the Am. Mining Jour. for 1860 (p. 435) left little more to be said, but the sections made last year by Mr. Alex. Murray of the Canada Geological Survey place the matter beyond all doubt. On Campment d'Ours, a small island near St. Joseph's, the sandstones of Sault St. Mary are seen reposing horizontally on the upturned edges of the Huronian rocks, and overlaid by limestones which contain in abundance the fossils of the Black River and

* Murchison, Quar. Jour. Geol. Society, Vol. xv. 353 and xvi. 215.

Birdseye divisions. The only fossil as yet found in these sandstones is a single *Lingula* from near Sault St. Mary, which may be either of Potsdam or Chazy age. The sandstones in question form the upper member of a series of strata which on Lake Superior attain a thickness of several thousand feet, and passing downwards we find a succession of limestones, marls and argillaceous sandstones, interstratified with greenstone and amygdaloid, and followed by about 2000 feet of bluish slates and sandstones, with cherty beds containing grains of anthracite, the whole underlaid by conglomerates, and reposing unconformably upon rocks of the Huronian system. The presence of such slates is the more significant from the occurrence already mentioned of fragments of green and black slates in the coarse grained sandstones near the base of the Potsdam, at Hemmingford mountain, showing the existence of argillaceous shales before the deposition of the quartzites of the Potsdam; these are perhaps more recent than the lowest shales of the Primordial zone, to which however, palæontologically they appear to belong.

This Quebec group is of considerable economic interest inasmuch as it is the great metalliferous formation of North America. To it belongs the gold which is found along the Appalachian chain from Canada to Georgia, together with lead, zinc, copper, silver, cobalt, nickel, chrome and titanium. I have long since called attention to the constant association of the latter metals, particularly chrome and nickel, with the ophiolites and other magnesian rocks of this series, while they are wanting in similar rocks of Laurentian age. Am. Jour. of Science (2) xxvi. 237.

The immense deposits of copper ores in Eastern Tennessee, and the similar ones in Lower Canada, both of which are for the most part in beds subordinate to the stratification, belong to this group. The lead, copper, zinc, cobalt and nickel of Missouri, and the copper of Lake Superior, also occur in rocks of the same age, which appears to have been pre-eminently the metalliferous period.

The metals of the Quebec group seem to have been originally brought to the surface in watery solution, from which we conceive them to have been separated by the reducing agency of organic matter in the form of sulphurets, or in the native state, and mingled with the contemporaneous sediments, where they occur in beds, in disseminated grains forming *fahlbands*, or as at Acton, are the cementing material of conglomerates. During the subsequent metamorphism of the strata these metallic matters being taken

into solution by alkaline carbonates or sulphurets, have been redeposited in fissures in the metalliferous strata, forming veins, or ascending to higher beds, have given rise to metalliferous veins in strata not themselves metalliferous. Such we conceive to be in a few words the theory of metallic deposits; they belong to a period when the primal sediments were yet impregnated with metallic compounds which were soluble in the permeating waters. The metals of the sedimentary rocks are now however for the greater part in the form of insoluble sulphurets, so that we have only traces of them in a few mineral springs, which serve to show the agencies once at work in the sediments and waters of the earth's crust. The present occurrence of these metals in waters which are alkaline from the presence of carbonate of soda, is as we have elsewhere pointed out, of great significance when taken in connection with the metalliferous character of certain dolomites, which as we have shown, probably owe their origin to the action of similar alkaline springs upon basins of sea water.

The intervention of intense heat, sublimation and similar hypotheses to explain the origin of metallic ores, we conceive to be uncalled for. The solvent powers of solutions of alkaline carbonates, chlorids and sulphurets at elevated temperatures, taken in connection with the notions above enunciated, and with De Senarmont's and Daubrée's beautiful experiments on the crystallization of certain mineral species in the moist way, will suffice to form the basis of a satisfactory theory of metallic deposits.*

The sediments of the carboniferous period, like those of earlier formations, exhibit towards the east a great amount of coarse sediments, evidently derived from a wasting continent, and are nearly destitute of calcareous beds. In Nova Scotia Sir William Logan found by careful measurement, 14,000 feet of carboniferous strata; and Professor Rogers gives their thickness in Pennsylvania as 8000 feet, including at the base 1400 feet of a conglomerate, which disappears before reaching the Mississippi. In Missouri Prof. Swallow finds but 640 feet of carboniferous strata, and in Iowa their thickness is still less, the sediments composing them being at the same time of finer materials. In fact, as Mr. Hall remarks, throughout the whole palæozoic period we observe a greater accumulation and a coarser character of sediments along the line of the Appalachian chain, with a gradual thinning westward, and a deposition of finer and farther transported matter in that direction. To the

* Quar. Jour. Geol. Soc. vol. xv. 580.

west, as this shore-derived material diminishes in volume, the amount of calcareous matter rapidly augments. Mr. Hall concludes therefore that the coal-measure sediments were driven westward into an ocean, where there already existed a marine fauna. At length, the marine limestones predominating, the coal measures come to be of little importance, and we have a great limestone formation of marine origin, which in the Rocky Mountains and New Mexico occupies the horizon of the coal, and itself unaltered, rests on crystalline strata like those of the Appalachian range. In truth, Mr. Hall observes, the carboniferous limestone is one of the most extensive marine formations of the continent, and is characterized over a much greater area by its marine fauna than by its terrestrial vegetation.

"The accumulations of the coal period were the last that gave form and contour to the eastern side of our continent, from the Gulf of St. Lawrence to the Gulf of Mexico ; and as we have shown that the great sedimentary deposits of successive periods have followed essentially the same course, parallel to the mountain ranges, we naturally inquire: What influence this accumulation has had upon the topography of our country, and whether the present line of mountain elevation from north-east to south-west is in any way connected with the original accumulation of sediments?" *Hall's Introduction*, p. 66.

The total thickness of the palæozoic strata along the Appalachian chain is about 40,000 feet, while the same formations in the Mississippi valley, including the carboniferous limestone, which is wanting in the east, have according to Mr. Hall, a thickness of scarcely 4000 feet.* In many places in this valley we find the Silurian formations exposed, exhibiting hills of 1000 feet, made up of horizontal strata, with the Potsdam sandstone for their base, and capped by the Niagara limestone, while the same strata in the Appalachians would give from ten to sixteen times that

* In Michigan, according to the late report of Prof. Winchell, the total observed thickness of the strata from the top of the Sault St. Mary sandstones to the top of the carboniferous series is little over 1700 feet, divided as follows :—Trenton and Hudson River groups, 50 feet, Upper Silurian 185, Devonian 782, Carboniferous 700 ; of this last the true coal measures constitute 123 feet, including from 3 to 10 feet of workable bituminous and cannel coals, while near the base of the carboniferous series are found 169 feet of gypsiferous marls, which yield strong brine springs.

thickness. Still, as Mr. Hall remarks, we have there no mountains of corresponding altitude, that is to say, none whose height, like those of the Mississippi valley, equals the actual vertical thickness of the strata comprising them. In the west there has been little or no disturbance, and the highest elevations mark essentially the aggregate thickness of the strata comprising them. In the disturbed regions of the east on the contrary, though we can prove that certain formations of known thickness are included in the mountains, the height of these is never equal to the aggregate amount of the formations. " We thus find that in a country not mountainous, the elevations correspond to the thickness of the strata, while in a mountainous country, where the strata are immensely thicker, the mountain heights bear no comparative proportion to the thickness of the strata." " While the horizontal strata give their whole elevation to the highest parts of the plain, we find the same beds folded and contorted in the mountain region, and giving to the mountain elevations not one-sixth of their actual measurement."

Both in the east and west, the valleys exhibit the lower strata of the palæozoic series, and it is evident that had the eastern region been elevated without folding of the strata, so as to make the base of the series correspond nearly with the sea level, as in the Mississippi valley, the mountains exposed between these valleys, and including the whole palæozoic series, would have a height of 40,000 feet; so that the mountains evidently correspond to depressions of the surface, which have carried down the bottom rocks below the level at which we meet them in the valleys. In other words, the synclinal structure of these mountains depends upon an actual subsidence of the strata along certain lines.

" We have been taught to believe that mountains are produced by upheaval, folding and plication of the strata, and that from some unexplained cause these lines of elevation extend along certain directions, gradually dying out on either side, and subsiding at the extremities. We have, however, here shown that the line of the Appalachian chain is the line of the greatest accumulation of sediments, and that this great mountain barrier is due to original deposition of materials, and not to any subsequent forces breaking up or disturbing the strata of which it is composed."

We have given Mr. Hall's reasonings on this subject, for the most part in his own words, and with some detail, for we

conceive that the views which he is here urging are of the highest importance to a correct understanding of the theory of mountains. In the *Canadian Naturalist* for Dec. 1859, p. 425, and in the *Am. Jour. Sci.* (2) xxx, 137 will be found an allusion to the rival theories of upheaval and accumulation as applied to volcanic mountains, the discussion between which we conceive to be settled in favour of the latter theory by the reasonings and observations of Constant-Prevost, Scrope and Lyell. A similar view applied to mountain chains like those of the Alps, Pyrennees and Alleghanies, which are made up of aqueous sediments, has been imposed upon the world by the authority of Humboldt, Von Buch and Elie de Beaumont, with scarcely a protest. Buffon, it is true, when he explained the formation of continents by the slow accumulation of detritus beneath the ocean, conceived that the irregular action of the water would give rise to great banks or ridges of sediments, which when raised above the waves must assume the form of mountains; later, in 1832, we find De Montlosier protesting against the elevation hypothesis of Von Buch, and maintaining that the great mountain chains of Europe are but the remnants of continental elevations which have been cut away by denudation, and that the foldings and inversions to be met with in the structure of mountains are to be looked upon only as local and accidental.

In 1856 Mr. J. P. Lesley published a little volume entitled *Coal and its Topography*, (12 mo. pp. 224,) in the second part of which he has, in a few brilliant and profound chapters, discussed the principles of topographical science with the pen of a master. Here he tells us that the mountain lies at the base of all topographical geology. Continents are but congeries of mountains, or rather the latter are but fragments of continents, separated by valleys which represent the absence or removal of mountain land [p. 126]; and again "mountains terminate where the rocks thin out." (p. 144.)

The arrangement of the sedimentary strata of which mountains are composed may be either horizontal, synclinal, anticlinal or vertical, but from the greater action of diluvial forces upon anticlinals in disturbed strata it results that great mountain chains are generally synclinal in their structure, being in fact but fragments of the upper portion of the earth's crust, lying in synclinals, and thus preserved from the destruction and translation which have exposed the lower strata in the anticlinal valleys, leaving the intermediate

mountains capped with lower strata. The effects of those great and mysterious denuding forces which have so powerfully modified the surface of the globe become less apparent as we approach the equatorial regions, and accordingly we find that in the southern portions of the Appalachian chain many of the anticlinal folds have escaped erosion, and appear as hills of an anticlinal structure. The same thing is occasionally met with further north; thus Sutton mountain in Canada, lying between two anticlinal valleys, has an anticlinal centre, with two synclinals on its opposite slopes. Its form appears to result from three anticlinals, the middle one of which has to a great extent escaped denudation.

The error of the prevailing ideas upon the nature of mountain chains may be traced to the notion that a disturbed condition of the rocky strata is not only essential to the structure of a mountain, but an evidence of its having been formed by local upheaval, and the great merit of De Montlosier and Lesley, (the latter altogether independently,) is to have seen that the upheaval has been in all cases not local but continental, and that the disturbance so often seen in the strata is neither dependent upon elevation nor essential to the formation of a mountain. The synclinal structure of portions of the Alps, previously observed by Studer and others, has been beautifully illustrated by Ruskin in the fourth volume of his *Modern Painters*, and in a late review of Alpine geology we have endeavoured to show that the Alps, *as a whole*, have likewise a synclinal structure. (Am. Jour. Science, xxix. 118.)

Such was the state of the question when Mr. Hall came forward bringing his great knowledge of the sedimentary formations of North America to bear upon the theory of continents and mountains. These were first advanced in his address delivered before the American Association for the Advancement of Science, as its president, at Montreal in August, 1857. This address was never published, but the author's views were brought forward in the first volume of his *Report on the Geology of Iowa*, p. 41, and with more detail in the introduction to the third volume of his *Paleontology of New York*, from which we have taken the abstract already given. He has shown that the difference between the geographical features of the eastern and central parts of North America is directly connected with the greater accumulation of sediment along the Appalachians. He has further shewn that so far from local elevation being concerned in the formation of these

mountains, the strata which form their base are to be found beneath their foundations at a much lower horizon than in the undisturbed hills of the Mississippi valley, and that to this depression chiefly is due the fact that the mountains of the Appalachian range do not, like those hills, exhibit in their vertical height above the sea the whole accumulated thickness of the palæozoic strata which lie buried beneath their summits.

Mr. Hall has made a beautiful application of these views to explain the fact of the height of the Greeu Mountains over the Laurentides, and of the White Mountains over the former, by remarking that we have successively the Lower and Upper Silurian strata superimposed on those of the Laurentian system. The same thing is strikingly shown in the fact that the higher mountain chains of the globe are composed of newer formations, and that the summits of the Alps are probably altered sediments of tertiary age. (Am. Jour. Sci. xxix. 118.)

The lines of mountain elevation of De Beaumont are according to Hall, simply those of original accumulations, which took place along current or shore lines, and have subsequently, by continental elevations, produced mountain chains. "They were not then due to a later action upon the earth's crust, but the course of the chain and the source of the materials were predetermined by forces in operation long anterior to the existence of the mountains or of the continent of which they form a part." p. 86.

It will be seen from what we have said of Buffon, De Montlosier and Lesley that many of the views of Mr. Hall are not new but old; it was, however, reserved to him to complete the theory and give to the world a rational system of orographic geology. He modestly says, "I believe I have controverted no established fact or principle beyond that of denying the influence of local elevating forces, and the intrusion of ancient or plutonic formations beneath the lines of mountains, as ordinarily understood and advocated. In this I believe I am only going back to the views which were long since entertained by geologists relative to continental elevations." p. 82.

The nature of the palæozoic sediments of North America clearly shows that they were accumulated during a slow progressive subsidence of the ocean's bed, lasting through the palæozoic period, and this subsidence, which would be greatest along the line of greatest accumulation, was doubtless, as Mr. Hall considers, connected with the transfer of sediment and the variations of local pres-

sure acting upon the yielding crust of the earth, agreeably to the view of Sir John Herschel. This subsidence of the ocean's bottom would, according to Mr. Hall, cause plications in the soft and yielding strata. Lyell had already in speculating upon the results of a cooling and contracting sea of molten matter, such as he imagined might have once underlaid the Appalachians, suggested that the incumbent flexible strata, collapsing in obedience to gravity would be forced, if this contraction took place along narrow and parallel zones of country, to fold into a smaller space as they conformed to the circumference of a smaller arc, " thus enabling the force of gravity, though originally exerted vertically, to bend and squeeze the rocks as if they had been subjected to lateral pressure.*

Admitting thus Herschel's theory of subsidence and Lyell's of plication, Mr. Hall proceeds to inquire into the great system of foldings presented by the Appalachians. The sinking along the line of greatest accumulation produces a vast synclinal, which is that of the mountain ranges, and the result of such a sinking of flexible beds will be the production within the greater synclinal of numerous smaller synclinal and anticlinal axes, which must gradually decline toward the margin of the great synclinal axis. This process the author observes appears to furnish a satisfactory explanation of the difference of slope on the two sides of the Appalachian anticlinals, where the dips on one side are uniformly steeper than on the other. p. 71.

An important question here arises, which is this ;—while admitting with Lyell and Hall that parallel foldings may be the result of the subsidence which accompanied the deposition of the Appalachian sediments, we inquire whether the cause is adequate to produce the vast and repeated flexures presented by the Alleghanies. Mr. Billings in a recent paper in the *Canadian Naturalist* (Jan. 1860), has endeavoured to show that the foldings thus produced must be insignificant when compared with the great undulations of strata, whose origin Prof. Rogers has endeavoured to explain by his theory of earthquake waves propagated through the igneous fluid mass of the globe, and rolling up the flexible crust. We shall not stop to discuss this theory, but call attention to another agency hitherto overlooked, which must also cause contraction and folding of the strata, and to which we have already alluded. (Am. Jour. Sci.(2)xxx. 138.) It is the condensation which must take place when porous sediments are converted into crystalline rocks like

* Travels in North America, 1st visit, vol. i. p. 78.

gneiss and mica slate, and still more when the elements of these sediments are changed into minerals of high specific gravity, such as pyroxene, garnet, epidote, staurotide, chiastolite and chloritoid. This contraction can only take place when the sediments have become deeply buried and are undergoing metamorphism, and is, as many attendant phenomena indicate, connected with a softened and yielding condition of the lower strata.

We have now in this connection to consider the hypothesis which ascribes the corrugation of portions of the earth's crust to the gradual contraction of the interior. An able discussion of this view will be found in the *American Journal of Science* (2) iii. 176, from the pen of Mr. J. D. Dana, who, in common with all others who have hitherto written on the subject, adopts the notion of the igneous fluidity of the earth's interior.

We have however elsewhere given our reasons for accepting the conclusion of Hopkins and Hennessy that the earth, instead of being a liquid mass covered with a thin crust, is essentially solid to a great depth, if not indeed to the centre, so that the volcanic and igneous phenomena generally ascribed to a fluid nucleus have their seat, as Keferstein and after him Sir John Herschel long since suggested, not in the anhydrous solid unstratified nucleus, but in the deeply buried layers of aqueous sediments which, permeated with water, and raised to a high temperature, become reduced to a state of more or less complete igneo-aqueous fusion. So that beneath the outer crust of sediments, and surrounding the solid nucleus, we may suppose a zone of plastic sedimentary material adequate to explain all the phenomena hitherto ascribed to a fluid nucleus. (Quar. Jour. Geol. Society, Nov. 1859. Canadian Naturalist, Dec. 1859, and Amer. Jour. Sci.(2)xxx. 136.)

This hypothesis, as we have endeavoured to show, is not only completely conformable with what we know of the behaviour of aqueous sediments impregnated with water and exposed to a high temperature, but offers a ready explanation of all the phenomena of volcanos and igneous rocks, while avoiding the many difficulties which beset the hypothesis of a nucleus in a state of igneous fluidity. At the same time any changes in volume resulting from the contraction of the nucleus would affect the outer crust through the medium of the more or less plastic zone of sediments, precisely as if the whole interior of the globe were in a liquid state.

The accumulation of a great thickness of sediment along a

given line would, by destroying the equilibrium of pressure, cause the somewhat flexible crust to subside; the lower strata becoming altered by the ascending heat of the nucleus would crystallize and contract, and plications would thus be determined parallel to the line of deposition. These foldings, not less than the softening of the bottom strata, establish lines of weakness or of least resistance in the earth's crust, and thus determine the contraction which results from the cooling of the globe to exhibit itself in those regions and along those lines where the ocean's bed is subsiding beneath the accumulating sediments. Hence we conceive that the subsidence invoked by Mr. Hall, although not the sole nor even the principal cause of the corrugations of the strata, is the one which determines their position and direction, by making the effects produced by the contraction not only of sediments, but of the earth's nucleus itself, to be exerted along the lines of greatest accumulation.

It will readily be seen that the lateral pressure which is brought to bear upon the strata of an elongated basin by the contraction of the globe, would cause the folds on either side to incline to the margin of the basin, and hence we find along the Appalachians, which occupy the western side of such a great synclinal, the steeper slopes, the overturn dips or folded flexures, and the overlaps from dislocation are to the westward, so that the general dip of the strata is to the centre of the basin, on the other side of which we might expect to find the reverse order of dips prevailing. The apparent exceptions to this order of upthrows to the south-east in the Appalachians appear to be due to small downthrows to the south-east, which are parallel to and immediately to the north-west of great upheavals in the same direction.

Mr. Hall adopts the theory of metamorphism which we have expounded in the paper just quoted above, *Canadian Naturalist*, Dec. 1859, (see also Am. Jour. Sci. (2) xxv. 287, 435, xxx. 135,) which has received a strong confirmation from the late researches of Daubrée. According to this view, which is essentially that put forward by Herschel and Babbage, these changes have been effected in deeply buried sediments by chemical reactions, which we have endeavored to explain, so that metamorphism, like folding, takes place along the lines of great accumulation. The appearance at the surface of the altered strata is the evidence of a considerable denudation. It is probable that the gneissic rocks of Lower Silurian age in North America were at the time of their crystallization overlaid by the whole of the palæozoic strata, while the

metamorphism of carboniferous strata in eastern New England points to the former existence of great deposits of newer and overlying deposits, which were subsequently swept away.

On the subject of igneous rocks and volcanic phenomena, Mr. Hall insists upon the principles which we were, so far as we know the first to point out, namely their connection with great accumulations of sediment, and of active volcanos with the newer deposits. We have elsewhere said: " the volcanic phenomena of the present day appear, so far as are aware, to be confined to regions of newer secondary and tertiary deposits, which we may suppose the central heat to be still penetrating, (as shewn by Mr. Babbage,) a process which has long since ceased in the palæozoic regions." To the accumulation of sediments then we referred both modern volcanos and ancient plutonic rocks; these latter, like lavas, we regard in all cases as but altered and displaced sediments, for which reason we have called them exotic rocks. (Am. Jour. Sci. (2) xxx. 133). Mr. Hall reiterates these views, and calls attention moreover to the fact that the greatest outbursts of igneous rock in the various formations appear to be in all cases connected with rapid accumulation over limited areas, causing perhaps disruptions of the crust, through which the semi-fluid stratum may have risen to the surface. He cites in this connection the traps with the palæozoic sandstones of Lake Superior, and with the mesozoic sandstones of Nova Scotia and the Connecticut and Hudson valleys.

It may sometimes happen that the displaced and liquified substratum will find vent, not along the line of greatest accumulation, but along the outskirts of the basin. Thus in eastern Canada it is not along the chain of the Notre Dame mountains, but on the north-west side of it that we meet with the great outbursts of trachyte and dolerite, whose composition and distribution we have elsewhere described. (Report of Geological Survey for 1858, and Am. Jour. Science, (2) xxix. 285.)

The North American continent, from the grand simplicity of its geological structure and from the absence, over great areas, of the more recent formations, offers peculiar facilities for the solution of some of the great problems of geology; and we cannot finish this article without congratulating ourselves upon the great progress in this direction which has been made within the last few years by the labors of American geologists.

Montreal, March 1, 1861.

ARTICLE VII.—*Correspondence of* JOACHIM BARRANDE, SIR WILLIAM LOGAN *and* JAMES HALL, *on the Taconic System and on the age of the Fossils found in the Rocks of Northern New England, and the Quebec Group of Rocks.*

(*From the American Journal of Science No.* 92, 1861.)

I. INTRODUCTORY REMARKS.

As some of our foreign readers may not be acquainted with the question to which the following important correspondence relates, we think it advisable to make a few explanatory observations by way of introduction. A complete history of the whole subject would require a greater amount of space than can be afforded, and we shall therefore touch only upon a few of the more salient points.

The rocks under discussion occupy a belt of country east and west from twenty to sixty miles wide, stretching from the vicinity of the city of New York in a northerly direction to Lake Champlain and thence through Vermont and Lower Canada to Cape Gaspé at the mouth of the St. Lawrence. The strata, consisting of slates, limestones, sandstones and conglomerates are greatly disturbed, plicated and dislocated, and are often, especially along the eastern side of the belt, in a highly metamorphic condition. On this side they are overlaid unconformably by Upper Silurian and Devonian rocks, but on the western and northern margin they are in contact with and in general seem to be a continuation of the Lower Silurian. Some of the slates of the formation closely resemble in lithological characters those of the Hudson River group, and thus along the western side of the region, where the junction of the two formations occurs, it is often almost impossible to draw the line between them. The dip and strike of both are in the same direction, and throughout extensive areas the newer rocks appear to plunge beneath the older. The whole district affords an excellent example of those cases, so well known to field geologists, where the true relations of the different masses cannot be clearly worked out without the aid of fossils, and where the best observers may arrive at diametrically opposite opinions.

Dr. Emmons, one of the geologists of the New York Survey, early convinced himself by a careful examination of these rocks, that they constituted a distinct physical group more ancient than the Potsdam sandstone, the latter being regarded by him as the base of the Lower Silurian System in North America. His

views were given in detail in 1842 in his final report on that part of the State confided to his charge, and in a more special manner in another work entitled "The Taconic System," published in 1844. In this latter work he figured several species of fossils which had been collected in different parts of the formation. Two of these were trilobites, and were described under the names of *Atops trilineatus* and *Elliptocephala asaphoides.* The others were graptolites, fucoids and apparently trails of annelides; he considered all the species to be distinct from any that had been found in American rocks of undoubted Silurian age. The pre-silurian age of the formation has also been maintained by him in several more recent publications such as his "American Geology"—the several reports on the geological survey of North Carolina and in his "Manual of Geology."

On the other hand, Professor Hall placed the whole region in the Hudson River group. In the first volume of the Palæontology of New York he identifies *Atops trilineatus* with *Triarthrus Beckii*, the characteristic trilobite of the Utica slate;—*Elliptocephala asaphoides* he refers to the genus *Olenus*, and describes as congeneric therewith, another trilobite (*O. undulostriatus*) said to be from the true Hudson River shales. It is scarcely necessary to state that these identifications have always afforded an extremely powerful objection against the correctness of the position assumed by Emmons, because no species of trilobite is known to range from the Primordial zone up to the top of the Lower Silurian. Hall's first volume was published in 1847 and as it is unquestionably the most important work on the Lower Silurian fossils of North America it has been very generally accepted by our physical geologists as a guide. It is not surprising therefore, that in all the discussions that have taken place during the last fourteen years upon the age of these rocks, the majority of those who did not profess to be naturalists should have arranged themselves on the side of the leading palæontologist of the country.

The formation was traced from New York through Vermont, and there identified by Prof. Adams, the State Geologist, with the Hudson River group. The Canadian Surveyors continued it with great labor through a mountainous and partially uninhabited country for nearly five hundred miles further, from the northern extremity of Vermont to the neighborhood of Quebec, and thence along the south side of the St. Lawrence to the mouth

of that river at Cape Gaspé. In Canada the nomenclature of the New York Survey was adopted for all the formations, and it appears from his several reports that Sir W. E. Logan could find nothing in the physical structure of the country to authorize him to make an exception in favor of this particular series of rocks. It has therefore always been called the Hudson River group in the publications of the Canadian Survey.

It will be seen by the following correspondence that the new light thrown upon the question of the age of these rocks by the fortunate discovery of a large number of fossils near Quebec, now leads Sir William to place them at the base of the Lower Silurian, and as he states that the shales in Vermont, in which the trilobites noticed in Mr. Barrande's letter to Prof. Bronn have been found, may be subordinate to the Potsdam, it seems probable that the sequence contended for by Emmons will turn out to be at least for the greater part the true one.

II.

On the Primordial Fauna and the Taconic System of Emmons, in a letter to Prof. Bronn of Heidelberg.*

"Paris, July 16, 1860.

"........ I have recently received, thanks to the kindness of Mr. E. Billings, the learned palæontologist of the Geological Survey of Canada, a very interesting pamphlet entitled 'Twelfth Annual Report of the Regents of the University of the State of New York, 1859.' If you possess this publication, you will find there, at page 59, a memoir of Prof. J. Hall, entitled 'Trilobites of the shales of the Hudson River group.' This *savant* there describes three species under the names *Olenus Thompsoni*, *Olenus Vermontana*, and *Peltura* (*Olenus*) *holopyga*. The well-defined characters of these trilobites are described with the clearness and precision to be expected from so skilful and experienced a palæontologist as James Hall.

"Although the specimens are incomplete, their primordial nature cannot admit of the least doubt, when the descriptions are read, accompanied with wood engravings, which the large dimensions of these three species render sufficiently exact. The first is 105 millim. long by 80 broad, the other two are somewhat smaller.

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* Proceed. Boston S. N. Hist., Vol. vii, Dec. 1860, p. 371.

"The heads of the two *Oleni* being injured, the furrows of the glabella cannot be recognized. The thorax has a common and remarkable character, which consists in the greater development of the third segment, the point of which is stronger and longer than in all the other pleura. This is a striking resemblance to the *Paradoxides*, the second segment of which has the same peculiarity. Besides, there is an intimate relation between these two primordial types, and we should not be surprised if America furnished us with forms uniting most of their characteristics. The pygidium of *O. Thompsoni*, the only one that is known, shows no segmentation, and attests by its exiguity its relation to a primordial trilobite. *P. holopyga*, by its whole appearance, resembles the Swedish species so well known by the name of *P. scarabœoides*.

"Thus all the characters of these three trilobites, as they are recognized and described by J. Hall, are those of the trilobites of the primordial fauna of Europe. This is so true, that I think I may say without fear, if M. Angelin, or any other palæontologist practised in distinguishing the trilobites of Scandinavia, had met with these three American forms in Sweden or Norway, he would not have hesitated to class them among the species of the primordial fauna, and to place the schists enclosing them in one of the formations containing this fauna. Such is my profound conviction, and I think any one who has made a serious study of the trilobitic forms and of their vertical distribution in the oldest formations will be of the same opinion.

"Besides, all who have seriously studied palæontology know well that each geological epoch, or each fauna, has its proper and characteristic forms, which once extinct reappear no more. This is one of the great and beautiful results of your immense researches, which have generalized this law, recognized by each one of us within the limits of the strata he describes.

"The great American palæontologist arrived long since at the same conclusion, for in 1847 he wrote the following passage in the *Introduction* to the first volume of the monumental work consecrated to the Palæontology of New York.

"'Every step in this research tends to convince us that the succession of strata, when clearly shown, furnishes conclusive proofs of the existence of a regular sequence among the earlier organisms. We are more and more able, as we advance, to observe that the Author of nature, though always working upon

the same plan and producing an infinite variety of forms almost incomprehensible to us, has never repeated the same forms in successive creations. The various organisms called into existence have performed their parts in the economy of creation, have lived their period and perished. This we find to be as true among the simple and less conspicuous forms of the palæozoic series, as in the more remarkable fauna of later periods.'—*J. Hall*, '*Pal. of New York*,' i. p. xxiii."

"When an eminent man expresses such ideas so eloquently, it is because they rise from his deepest convictions. It must then be conceived that Mr. Hall, restrained by the artificial combinations of stratigraphy previously adopted by him, has done violence to his palæontological doctrines, when, seeing before him the most characteristic forms of the *Primordial fauna*, and giving them names the most significant of this first creation, he thinks it his duty to teach us that these three trilobites belong to a horizon superior to that on which the second fauna is extinguished.

"In effect, according to the text of Mr. Hall, the three trilobites in question were found near the town of Georgia, Vermont, in schists which are superior to the true Hudson River group. In his works Mr. Hall does not go beyond indicating the horizon of certain fossils, and no one would think of asking from him a guaranty for such indications. But on this occasion the great American palæontologist thinks it necessary to support his stratigraphical determination by another authority, chosen from the most respectable names in geology. The following is the note which terminates his Memoir.

"'Note.—In addition to the evidence heretofore possessed regarding the position of the shales containing the Trilobites, I have the testimony of Sir W. E. Logan, that the shales of this locality are in the upper part of the Hudson River group, or forming a part of a series of strata which he is inclined to rank as a distinct group, above the Hudson River proper. It would be quite superfluous for me to add one word in support of the opinion of the most able stratigraphical geologist of the American continent.'

"Now, when a *savant* like Mr. Hall thinks himself obliged to invoke testimony to guarantee the exactness of the position of certain fossils, it is clear that the determination of this position presents some difficulties.

"In order to understand these difficulties I have consulted the

maps and documents relating to the State of Vermont and the country in which the town of Georgia is situated, and although the library of our Geological Society does not contain all that one could wish on this subject, I recognized easily that Georgia is placed in the region where the order of succession of the deposits is the most obscured by foldings and dislocations; so that the position of the schists in question could not have been determined by the incontestable evidence of direct superposition. Besides, the physical appearance of these schists is not that of the rocks constituting the typical group of Hudson River. This is verified by the note of Mr. Hall, for he tells us that Sir W. E. Logan is inclined to make a distinct group of these schists superior to that of the Hudson, and which consequently would crown the whole Lower Silurian division of the continent.

"For the above reasons, the geological horizon on which the three *Oleni* of Georgia were found appears to me, at first view, to have been but doubtfully determined, and in complete opposition to palæontological documents.

"I do not think, then, that I weaken in the least degree the respect and confidence justly inspired by the labors of the American *savants* whose names have just been mentioned, when I ask them in the name of science to make new researches and new studies, that may lead to a final and certain solution of this important question.

"Doubtless, thanks of the progress of our knowledge, we are now no longer bound by the ancient conception of the simultaneous extinction and the total renovation of the faunæ. As for myself, in particular, it would not be possible to accuse me of similar views at the moment when I am publishing the explanation of my doctrine of colonies. But you will perceive that the facts which I invoke in support of this doctrine are far from sustaining the reappearance of a fauna after the extinction of the following fauna, which the three trilobites of Georgia would do, if they had really lived after the deposit of the Hudson River group.

"This reappearance would be still more astonishing, as among the three great Silurian faunæ the second fauna occupies the greatest vertical space and is probably the one which enjoyed the longest existence. Thus, to verify such a reappearance, the most incontestable proofs are required, for such a decision would compel the entire re-formation of one of our most important scientific creeds.

"Yours, very truly,

J. BARRANDE."

In another letter, dated Paris, 14th August, 1860, Mr. Barrande says:—

"You will easily perceive the interest and importance of the question, even if it were only raised on account of the three *Oleni* of Georgia; but it takes it now a much wider field, owing to a letter I have just received from Mr. Billings, official palæontologist of the Geological Survey of Canada, who informs me that he has found lately, in the schists and limestones near Quebec, considered as being the prolongation of those in question in Vermont, nearly one hundred species, almost all new. Twenty-six of these come from a white limestone, and seem to him to be the true representatives of the Primordial fauna, and he cites among them *Conocephalites*, *Arionellus*, *Dikellocephalus*, etc., that is, very characteristic forms of this fauna.

"In another limestone, which is gray, he finds thirty-nine species, all different from the first, and representing, on the contrary, the most distinct types of the second fauna. Finally, the black schists furnish him with *Graptolites*, *Lingulæ*, etc., etc., fossils which at first sight cannot determine a horizon, because they are found upon several Silurian horizons.

"While waiting for these very obscure stratigraphical relations to be disentangled, and without committing in any manner Mr. Billings, who should preserve the independence of his opinion, I may yet express to you my view wholly personal, and of which at this moment I take the entire responsibility. I think, then, that this region of schists and limestones of Vermont, in other words the *Taconic system*, will reproduce in America what took place in England as to the Malvern Hills, and in Spain for the Cantabrian chain,—that is to say the Primordial fauna, after having been disregarded, will regain its rights and its place, usurped for a time by the second fauna.

"You see it is a great and noble question, whose final solution will complete the imposing harmonies existing already between the series of palæozoic faunæ of America and that of the contemporaneous faunæ of Europe, leaving to each the imprint peculiar to its continent.

"I can well imagine, from the position previously taken by our learned American brethren on the subject of the Taconic system, that the final solution of which I speak will not be obtained without debate, and perhaps some wounding of self-love, for some opinions that appear to be dominant must be abandoned.

"But experience has taught me that in such cases the most elevated minds turn always first to the light, and put themselves at the head of the movement of reform. Thus, when in 1850 I recognized the Primordial fauna in the Malvern Hills, where the second fauna only had been found, Sir Henry de la Beche and Sir Roderick Murchison were the first to adopt my views, to which little by little the other official geologists agreed; Edward Forbes ranged himself publicly on my side in 1853 in The Geological Survey, while others still hesitated, until now there is no longer any opponent.

"I think there will be the same experience in America, and that in a few years from this time the opinions of your *savans* will have undergone a great change as regards this question.

"It is a fine opportunity for Dr. Emmons to reproduce his former observations and ideas with more success than in 1844.

"Yours very truly,

J. BARRANDE."

III.

SIR WILLIAM LOGAN'S LETTER TO J. BARRANDE,

Vol. V. page 472, ante.

IV.

LETTER FROM JAMES HALL, PALÆONTOLOGIST OF NEW YORK, TO THE EDITORS OF THE AMERICAN JOURNAL OF SCIENCE AND ARTS.

GENTLEMEN,—In the Twelfth Annual Report of the Regents of the University* upon the State Cabinet of Natural History, I published descriptions of three species of trilobites from the shales of the town of Georgia in Vermont, referring them to the age of the Hudson River group. These trilobites had been in my possession for some two years or more; and knowing the great interest that would attach to them, whenever published, I had waited, hoping that some new facts might be brought out touching the stratigraphical relations of these rocks in the town of Georgia.

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* The same to which Mr. Barrande refers in his text to Prof. Bronn, p. 312. The preceding communications sufficiently explain the subject under discussion.

After the descriptions had been printed and a few copies distributed, I learned that Sir William Logan was at that time actually investigating the rocks of that part of Vermont. Desiring to know the results of his latest researches in regard to the stratigraphical relations of these rocks, I withheld the final publication till the meeting of the American Association for the Advancement of Science, in Springfield, and there showed to Sir William my descriptions as they now stand in the report, and I then received his authority for the addition of the note which was appended.

This in a few words is a simple history of the matter relating to the publication of these species. I made no remarks or comparisons with the primordial fauna of Barrande in Bohemia, knowing that these features would be at once recognized by every palæontologist; while their reference to the genus *Olenus* showed my appreciation of the nature of the fossils.

I received a copy of the communication of Mr. Barrande, from Sir William Logan in September, a few days before setting out for my field duties in Wisconsin. Since my return to Albany, constant and pressing occupation has left me no time to consider a reply to a question of so much importance.

Later discoveries in the limestones associated with the shales at Quebec leave no longer a doubt, if any could have been entertained before, that the shales of Georgia, Vermont, are in the same relative position; and we must regard these three trilobites as belonging to the same fauna with the species enumerated by Sir William Logan as occurring in the Quebec group. Left to palæontological evidence alone, there could never have been a question of the relations of these trilobites, which would at once have been referred to the primordial types of Barrande.

Sir William Logan yields to the palæontological evidence, and says, "*there must be a break.*" He gives up the evidence of structural sequence which he had before investigated and considered conclusive; and having heretofore relied upon the opinion of the distinguished geologist of Canada in regard to a region of country to which my own examinations have not extended, I have nothing left me but to go back to the position sustained by palæontological evidence. Let us for a moment examine this palæontological evidence.

The identifications of the fosssils of the Quebec group certainly show a remarkable agreement between the trilobites of this group

and those of the Potsdam sandstone, in the occurrence of six species of *Dikellocephalus* and one of *Menocephalus*; while the occurrence of many others is in agreement or not incompatible with the fauna of the Potsdam and Calciferous sandstones. The comparative values of the trilobitic faunæ of this group and of the primordial zone of Europe, as established by Barrande, is better shown in a tabular form which I here append.

The Crustacean fauna of the primordial zone of Europe.

Paradoxides, -	These genera are all limited to the *primordial fauna*, and none of the other European genera of trilobites are known in this fauna.
Olenus, - -	
Peltura, - -	
Conocephalus, -	
Ellipsocephalus,*	
Hydrocephalus, -	
Sao, - - -	
Arionellus, -	
Agnostus, - -	Of the first and second fauna.
Amphion, - -	Placed with doubt in the first fauna, and is well developed in the second fauna.

The Crustacean fauna of the Quebec Group.

Conocephalus, -	Genera of the *primordial zone.*
Arionellus, -	
Agnostus, - -	A genus passing from the first to the second fauna.
Dikellocephalus, -	Genera of the Potsdam period.
Menocephalus -	
Bathyurus, -	Quebec group.
Asaphus, - -	Of the second fauna.
Illænus, - -	Of the second and third fauna.
Amphion, - -	Of the second fauna; and doubtfully of the first fauna in Sweden.
Ceraurus = Cheirurus,	Of the second and third Silurian faunæ, and of the Devonian fauna.

We have therefore in the Quebec Group, two established genera of the primordial zone; one, *Agnostus*, which passes from the primordial to the second fauna; one, *Amphion*, cited as doubtful in the first fauna in Sweden, and known to be in the second; and three,—*Asaphus*, *Illænus* and *Cheirurus*, which begin their existence in the second fauna. Of these, Asaphus begins and ends in the second; *Illænus* begins with the second and continues to the third; while *Ceraurus* = *Cheirurus* begins in the second, extends through the third Silurian, and appears in the Devonian fauna.

* Not *Elliptocephalus* of Emmons.

Bathyurus is a new genus, and as yet has no stratigraphical value in comparisons. Those which I described as *Olenus* have proved to be not true *Oleni*, and though much resembling that genus, are nevertheless distinct; I have proposed the name *Barrandia* and *Bathynotus* for the two forms.* These have yet no stratigraphical value, except so far as their relations to established genera may aid in that direction.

The genera *Dikellocephalus* and *Menocephalus* are of the Potsdam group; and so far the Quebec group is in parallelism with the Potsdam and Calciferous strata.

Of the other genera, we know *Asaphus*, *Illœnus* and *Ceraurus* (= *Cheirurus*) in the Trenton limestone and Hudson River groups; *Illœnus* and *Ceraurus* in the Upper Silurian strata of Niagara age, or the third fauna of Barrande; while *Ceraurus* occurs also in the Devonian of Europe. *Amphion* is known in the second fauna in Europe, and, doubtfully in the first.

Ceraurus does not occur in this country, so far as I know, above the Niagara group, though known in the Devonian rocks of Europe.

The following tabular arrangement of the genera found in the Quebec group will serve to express more distinctly the relations of the crustacean fauna of these rocks.

The letters at the head of the columns have the same references as those used in the communication of Sir William Logan.

	A	A^1	A^2	A^3	A^4	B^1	B	B^3
Arionellus..............	.....	—	4	.....	....	....	....	.....
Conocephalus,...........	.....	—	1	.....	....	....	....	.....
Agnostus..............	.....	—	3	1	....	....	....	.....
Dikellocephalus, ...	.....	—	6	.....	....	....	....	.....
Menocephalus,...........	—	1	—	—	—	....	....	.....
Bathyurus, ...	.....	—	.....	4	1	....	....	1
Barrandia, } *Shales of*	.....	.....	.....	.....	....	....	....	.....
Bathynotus, } *Georgia, Vt.*	.....	.....	.....	.....	....	....	....	.....
Amphion,...............	.....	.....	....	2	....	....	....	.....
Asaphus,...............	.....	1	.....	.....	1	....	....	1
Illænus,...............	.....	.....	.....	.....	....	....	....	2
Cheirurus (Ceraurus),....	.....	.....	.....	2	....	....	....	.....
Leperditia,.............	.....	.....	.....	.....	....	....	1	.....
Lingula,...............	2	—	2	.....	....	....	....	.....
Discina,...............	.....	—	1	.....	....	....	....	.....
Orthis,................	1	—	1	2	1	11	1	3
Leptæna,...............	.....	—	1	1	....	1	....	.....
Strophodonta, ...	.....	—	.....	1	....	....	....	.....
Camarella,.............	.....	.....	1	1	1	....	1	.....

* Thirteenth Annual Report of the Regents of the University of N. Y., on the State Cabinet of Natural History, Albany, December, 1860.

	A	A[1]	A[2]	A[3]	A	B	B[2]	B[3]
Cyrtodonta?	....	....	....	1	....	....	....	....
Maclurea,	....	....	....	....	....	....	....	1
Murchisonia,	....	....	....	3	....	....	....	1
Pleurotomaria,	....	....	....	7	....	....	....	2
Helicotoma,	....	....	....	2	....	....	....	1
Straparollus,	....	....	....	2	....	....	....	....
Capulus	....	....	....	2	....	....	....	....
Ophileta,	....	....	....	....	....	....	....	1
Nautilus,	....	....	....	....	....	....	1	1
Orthoceras,	....	....	....	....	....	....	1	3 or 4
Cyrtoceras,	....	....	....	....	....	....	....	1
Crinoidal columns,	....	....	....	....	....	....	3	....
Tetradium,	1	....	....	....	....	....	....	....
Dictyonema,	3	....	....	1	....	....	....	....
Graptolithus,	25	....	....	....	....	....	....	....
Retiolites,	1	....	....	....	....	....	....	....
Reteograptus,	2	....	....	....	....	....	....	....
Phyllograptus,	5	....	....	....	....	....	....	....
Dendrograptus,	3	....	....	....	....	....	....	....
Thamnograptus,	3 [?]	....	....	....	....	....	....	....

In this table we find, of previously recognized trilobites of the primordial fauna, two genera and five species; of previously known genera of the second and third faunæ, four genera and eight species; two genera before known in the Potsdam sandstone and seven species; and of *Agnostus*, which is of the first and second faunæ, two species; and one new genus with nine species.

These are certainly very curious results; and a modification of our views is still required to allow four genera and eight species, (or leaving out *Amphion*) three genera and six species of the trilobites of the second fauna to be associated with two genera and five species of trilobites of the primordial fauna, and yet regard the rock as of primordial origin.

The brachiopodous genera, *Lingula*, *Discina*, *Orthis*, *Leptœna* and *Strophomena*, have a great vertical range, and are known in the Lower and Upper Silurian, and most of them in the Devonian; while *Camerella* so far as known is a Lower Silurian form of the second fauna (perhaps also in a lower position).

Of the gasteropoda, *Maclurea* and *Ophileta* are restricted to Lower Silurian rocks, but occur mainly in the second fauna. The other genera occur likewise in the second fauna and in the Upper Silurian rocks as well as some of them in Devonian. The same is true of the cephalopoda enumerated.

Tetradium is known in the second fauna of the Lower Silurian

rocks, and in the upper part of the Hudson River group at the west. *Dictyonema* is a genus known from Lower Silurian to Devonian strata.

Graptolithus proper extends to the Clinton group of New York; and the same is true of *Reteograptus*. *Tamnograptus* occurs in the rocks of the Hudson River group near Albany, and in the Quebec rocks. *Phyllograptus* and *Retiolites* are known in the Quebec rocks only; while the typical form of *Dendrograptus* occurs in the Potsdam sandstone, and, likewise, in three other species, in the Quebec rocks.

We find, therefore, in the other genera, except trilobites, very little satisfactory evidence on which to rely in the present state of our knowledge, for determining the position of these strata.

In the present discussion, it appears to me necessary to go further, and to inquire in what manner we have obtained our present ideas of a primordial, or of any successive faunæ. I hold that in the study of the fossils themselves there were no means of such determination prior to the knowledge of the stratigraphical relations of the rocks in which the remains are inclosed. There can be no scientific or systematic palæontology without a stratigraphical basis. Wisely then, and independently of theories, or of observations and conclusions elsewhere, geologists in this country had gone on with their investigations of structural geology. The grand system of the Professors W. B. and H. D. Rogers had been wrought out not only for Pennsylvania and Virginia but for the whole Appalachian chain; and the results were shown in numeous carefully worked sections. In 1843, '44 and '45 I had myself several times crossed from the Hudson River to the Green Mountains, and found little of importance to conflict with the views expressed by the Professors Rogers in regard to the chain farther south, except in reference to the sandstone of Burlington, and one or two other points, which I then regarded as of minor importance.

Sir William Logan had been working in the investigations of the geology of Canada; and better work in physical geology has never been done in any country.

This then was the condition of American geology, and investigators concurred, with little exception, in the sequence based on physical investigations. As I have before said, our earliest determinations of the successive faunæ depend upon the previous stratigraphical determinations. This I think is acknowledged

by Mr. Barrande himself, when he presents to us, as a preliminary work, a section across the centre of Bohemia. With all willingness to accept Mr. Barrande's determination, fortified and sustained as it is by the exhibition of his magnificent work upon the trilobites of these strata, we had not yet the means of parallelizing our own formations with those of Bohemia by the fauna there known. The nearest approach to the type of primordial trilobites was found in those of the Potsdam sandstone of the northwest, described by Dr. D. D. Owen; but none of these had been generically identified with Bohemian forms;* and the prevailing opinion, sanctioned as I have understood by Mr. Barrande, was that the primordial fauna had not been discovered in this country, until the re-discovery of the *Paradoxides Harlani*, at Braintree, Mass. The fragmentary fossils published in vol. 1, Palæontology of New York, and similar forms of the so-called Taconic system, were justly regarded as insufficient to warrant any conclusions. It then became a question for palæontologists to decide, whether determinations founded on a physical section in a disturbed and difficult region of comparatively small extent, were to be regarded as paramount to determinations founded on examinations, like those of the Professors Rogers, extending over a distance in the line of strike of five or six hundred miles; and those of Sir William Logan over nearly as great an extent from Vermont to Gaspé.

It is not possible for me, at this moment, to give the time necessary for a full discussion of this important subject. In presenting these few facts in this form, I am far from doing it in the spirit of cavilling, or as an expression of distrust in any direction. It is plain that the case is not met in Mr. Barrande's plan of successive trilobitic faunæ; and the facts yet brought out do not serve to clear up the difficulty. It is evident that there is an important and perplexing question to be determined,—one that demands all the wisdom and sagacity of the most earnest inquirers, and one which calls for the application of all our knowledge in stratigraphical geology and in palæontology;—one in which coöperation, good will and forbearance are required from every one, to harmonize the conflicting facts as they are now presented. The occurrence of so many types of the second fauna in the rocks at Point Levi, associated with a smaller number of estab-

* The glabellæ of small trilobites undistinguishable from *Conocephalus* occur in the Potsdam sandstone near Trempaleau, Wisconsin, on the Mississippi river.

lished primordial types, offers us the alternative of regarding these strata as of the second stage, with the reappearance of primordial types in that era, or of bringing into the primordial zone several genera heretofore regarded as beginning their existence in the second stage: in either case, so far as now appears, conflicting with the scheme of Mr. Barrande in reference to the successive faunæ of trilobites as established in Bohemia and the rest of Europe.

For myself I can say, that no previously expressed opinion, nor any "*artificial combinations of stratigraphy previously adopted*" by me, shall prevent me from meeting the question fairly and frankly. I have not sought a controversy on this point, but it is quite time that we should all agree that there is something of high interest and importance to be determined in regard to the limitation of the successive faunæ of our older palæozoic rocks.

I am, yours, &c.,

James Hall.

Albany, N.Y., Jan. 23, 1861.

ARTICLE VIII.—*Catalogue of Plants collected in the Counties of Argenteuil and Ottawa, in* 1858. By W. S. M. D'Urban.

The following list of Plants contains 362 species, all of which were collected strictly within the Laurentian district, many introduced species growing on the fossiliferous rocks in the immediate neighbourhood of the town of Grenville, being omitted. A large portion were determined by myself on the spot with the aid of Dr. Asa Gray's admirable "Manual of the Botany of the Northern United States," which was my almost constant companion during the five months I spent in the district, but I have to acknowledge my obligations to Mr. G. Barnston, who kindly assisted me in naming some phenogamous species; to Col. Munro, C. B., 39th Regt., who most obligingly determined the whole of the sedges and grasses; to Mr. D. Allan Poe, who examined the cryptogams, and named all the mosses, some of which he submitted to the eminent bryologist, Mr. James of Philadelphia; and lastly to Dr. Dawson for allowing me unlimited access for purposes of reference to the Holmes herbarium deposited in McGill College.

Many of the specimens collected were so small and depauperated in form, from the poverty and scantiness of the soil that I found it

very difficult to recognise them at the first glance, and even when compared with specimens gathered in the rich limestone districts, it was with difficulty I could believe them to be the same species, until I had made a very close examination.

A considerable number of European plants were found round clearings, lumber roads, and along the banks of the Rouge, and I have indicated such as were obviously introduced, by an asterisk. (*)

For the sake of brevity I have given the English names of some of the commoner species only, and in general those under which they are known to the settlers and lumbermen. With the assistance of the other members of our party, I was enabled to obtain the Indian names of a few species, and they will be found below, spelled, I believe correctly, in accordance with their pronunciation. They were furnished by the son of the Algonquin chief of the Indian settlement on the Rouge, in the township of Arundel, called "Chi-chick" (pronounced Shes-sheep), who could read and write his own language, and understood both English and French.

I have given the dates at which I found most of the flowering species in full flower, (F.) and their fruit ripe, (F. R.) believing they may be useful in indicating the climate of the district.

When no locality in particular is mentioned the plant was distributed over the whole district.

London, England, May 16th, 1860.

Ranunculaceæ (Crowfoot Family).

Clematis Virginiana, Linn. Abundant in swamps; F. 12th August.

Anemone Pennsylvanica, Linn. In great abundance and luxuriance on a clearing near the Devil's rapids on the Rouge; F. 30th June to 18th July.

Thalictrum cornuti, Linn. Abundant in moist places; F. 16th July.

Ranunculus Flammula, Linn., var. reptans. Amongst stones by the water-side, River Rouge, near Silver Mountain; F. 5th August.

" Pennsylvanicus, Linn. Abundant in wet places, Hamilton's Farm; F. 30th June.

* " acris, Linn. Clayey banks of the Rouge and round clearings; F. 13th June.

Caltha palustris, Linn. Marshy ground, clearings along Chatham, North Town.

Coptis trifolia, Salisb. Very abundant in rocky woods and swamps; F. 31st May.

Aquilegia Canadensis, Linn. A few stunted plants on gneiss rocks, Sixteen Island Lake; F. 3rd June.

Actæa spicata, Linn., var. rubra, Michx. Abundant in rocky woods; F. R., end of July.

" " var. alba, Michx. Woods near Hamilton's Farm.

Cabombaceæ (Water-shield Family).

Brasenia peltata, Pursh. Abundant in lakes and ponds.

Nymphæaceæ (Water-lily Family).

Nymphæa odorata Ait. Bark Lake, Arundel; F. 17th July.

Nuphar advena, Ait. Abundant in most lakes; F. 28th June.

Sarraceniaceæ (Pitcher-plant Family).

Sarracenia purpurea, Linn. (Ta-na-da-tas, Algonquin). Common in bogs or Beaver-meadows; F. July.

Papaveraceæ (Poppy Family).

Sanguinaria Canadensis, Linn. (Blood root). Clearings on crystalline limestone, Wentworth.

Fumariaceæ (Fumitory Family).

Dicentra Cucullaria, DC. Abundant in woods on crystalline limestone; F. 15th May.

Corydalis glauca, Pursh. Sparingly on gneiss rocks, Sixteen Island Lake and Huckleberry rapids on the Rouge; F. 15th June to 17th July.

Cruciferæ (Mustard Family).

Dentaria diphylla, Linn. (Indian Pepper). Rocky woods; F. 30th May.

Cardamine hirsuta, Linn. A very small form; growing submerged by the sides of the Rouge near Silver Mountain, and in wet places on Hamilton's Farm.

*Capsella bursa-pastoris, Mœnch. Abundant about clearings.

Violaceæ (Violet Family).

Viola rotundifolia, Michx. Locality not noted.

" blanda, Willd. Rich woods, generally on limestone; F. 17th May.

" Selkirkii, Goldie. Gate Lake, Wentworth; F. 17th May.

" cucullata, Ait. Very abundant and luxuriant about the French settlement in Wentworth, also moist places about clearings on Bevin's Lake, Montcalm; F. 4th June.

" Canadensis, Linn. Very abundant and luxuriant, French settlement, Wentworth; F. 4th June.

" pubescens, Ait. Rich low woods on crystalline limestone; F. beginning of June.

Droseraceæ (Sun-dew Family).

Drosera longifolia, Linn. Sphagnum and swamp round a small pond near the Indian Village on the Rouge, and on pine logs in a small lake near Lake of Three Mountains.

Hypericaceæ (St. John's-wort Family).

Hypericum ellipticum, Hook. Sandy banks of the Rouge; F. 14th July to 21st August.

Caryophyllaceæ (Pink Family).

*Silene noctiflora, Linn. Abundant on the clearings, Indian Village, Arundel; F. 16th July.

*Agrostemma Githago, Linn. Amongst wheat, clearing near Bevin's Lake; F. 7th July.

Stellaria borealis (?) Bigelow. Bevin's Lake, Montcalm.

*Cerastium vulgatum, Linn. Common amongst grass at Hamilton's Farm.

Portulacaceæ (Purslane Family).

Claytonia Caroliniana, Michx. (Ground-nut). Very abundant, low, rich woods on limestone; F. 15th May.

Tiliaceæ (Linden Family).

Tilia Americana, Linn. (Bass-wood). Abundant, reaching a large size on alluvial soil and limestone.

Oxalidaceæ (Wood-sorrel Family).

Oxalis Acetosella, Linn. Abundant in rocky woods and swamps; F. 28th June.

* " stricta, Linn. On sand, mouth of the Devil's River, Huckleberry Rapids and Hamilton's Farm.

Geraniaceæ (Geranium Family).

Geranium Carolinianum, Linn. Extremely depauperated on gneiss rocks, Huckleberry Rapids.

Balsaminaceæ (Balsam Family).

Impatiens fulva, Nutt. Abundant in moist places; F. 21st August.

Anacardiaceæ (Cashew Family).

Rhus typhina, Linn. Sparingly and very small about Hamilton's Farm; common about Grenville.

" Toxicodendron, Linn. (Poison ivy). Abundant on rocks and sand; F. R. 3rd August.

Vitaceæ (Vine Family).

Ampelopsis quinquefolia, Michx. Abundant on damp ground in open places.

Sapindaceæ (Soap-berry Family).

Acer Pennsylvanicum, Linn. (Dogwood). Abundant in rocky woods generally on gneiss; F. 13th June.

" saccharinum, Wang. (Hard Maple). Very abundant on all soils, but especially fine on limestone and drift. The young trees compose the greater part of the underwood throughout the distinct.

" rubrum, Linn. (Soft or water maple). Very abundant on low ground along the Rouge, but scarce in other places; F. 25th May.

Leguminoseæ (Pulse Family).

*Trifolium pratense, Linn. Common along the banks of the Rouge and round clearings; F. 30th June.

* " repens, Linn. (White clover). Abundant on the banks of the Rouge and round clearings.

Desmodium Canadense, DC. Huckleberry rapids: F. 3rd August.

Amphicarpæa monoica, Nutt. Common in swamps and along the banks of the Rouge; F. 8th August.

Rosaceæ (Rose Family).

Prunus pumila, Linn. On gneiss and limestone rocks near Mr. Thompson's clearing and at Huckleberry rapids; F.R. 3rd August.

" Pennsylvanica, Linn. Forming dense thickets where White Pine has been destroyed by fire; F. R. 23rd July.

" Virginiana, Linn. (Choke cherry). Occurred sparingly in woods and at Hamilton's Farm.

Spiræa salicifolia, Linn. In profusion everywhere along the shores of the Rouge and lakes; F. 21st July.

" tomentosa, Linn. Sparingly on the margins of small lakes near Hamilton's Farm.

Agrimonia Eupatoria, Linn. Common in open places, damp woods, &c.

Geum album (?) Gmelin. Huckleberry rapids and near Silver Mountain.

Potentilla Norvegica, Linn. Abundant round clearings; F. 18th July.

" arguta (?) Pursh. Banks of the Rouge near Devil's rapids.

" palustris, Scop. Abundant in shallow parts of Chain lake. also observed in Bevin's lake, Montcalm, and growing on gneiss rock by the side of the lake on Silver Mountain.

Fragaria Virginiana, Ehrh. Abundant in open places; F. R. 23rd July.

" vesca, (?) Linn. A large strawberry was growing in great profusion and luxuriance near the French settlement in Wentworth, the specimens collected were lost; F. 4th June.

Dalibarda repens, Linn. Abundant in rock woods; F. 2nd July to August.

Rubus odoratus, Linn. (Scotch-cap). Sparingly Dolan's lake, Grenville and Sugar-bush lake, Montcalm. Abundant about Grenville.

" triflorus, Richardson. Abundant in rocky woods; F. end of May, F. R. 30th June.

" strigosus, Michx. (Wild raspberry). Abundant round burnt clearings, sandy banks of the Rouge, &c.; F. 30th June, F. R. 23rd July.

" villosus, Ait. (Blackberry). Abundant in lumber roads and tamarack swamps near Hamilton's Farm and Indian Village; F. 17th July, F. R. 4th September.

" Canadensis, Linn. Sandy and rocky places, Sugar-bush lake and Hamilton's Farm; F. 28th June.

Rosa blanda, Ait. (Ki-nau-ki-te-me-ka-che, Algonquin). Abundant on the sandy and clayey banks of the Rouge, and on the rocks, Huckleberry rapids; F. 30th June.

Cratægus coccinea, Linn. Sugar-bush lake, Montcalm. Common about Grenville.

Pyrus arbutifolia, Linn. var. erythrocarpa. Gneiss Island, Trembling lake. Var. melanocarpa. Swamp near Hamilton's Farm and Bark lake, Montcalm.

" Americana, DC. (Rowan or Mountain Ash). Common in rocky woods.

Amelanchier Canadensis, Torr. & Gray. var. Botryapium (Indian Pear). Abundant on gneiss rocks in open places; F. 31st May, F. R. 11th July.

Onagraceæ (Evening-primrose Family).

Epilobium angustifolium, Linn. (Fire-weed). Very abundant on burnt clearings and along the clayey banks of the Rouge; F. 16th July.

" coloratum, Muhl. Sandy banks of the Rouge near Silver Mountain.

Œnothera biennis, Linn. Very abundant; sandy shores of the Rouge and Bevin's lake; F. 19th July to 21st August.

" pumila, Linn. On sand, Bevin's lake, near Thompson's clearings and Devil's rapids; F. 8th July.

Circæa alpina, Linn. In profusion in low damp woods, on fallen trees, &c.; F. 28th June.

Grossulaceæ (Currant Family).

Ribes Cynosbati, Linn. (Wild gooseberry). Abundant in rocky woods; F. R. 7th August.

" lacustre, Poir. Abundant in swampy woods; F.R. 3rd August.

" prostratum, L'Her. (Musk currant). Common in rocky woods; F. 31st May.

" rubrum, Linn. Abundant round clearings; F. R. 18th July.

Saxifragaceæ (Saxifrage Family).

Mitella nuda, Linn. Abundant amongst moss at the roots of trees in moist woods; F. 19th June.

Tiarella cordifolia, Linn. Very abundant in rocky and sandy woods.

Chrysosplenium Americanum, Schwein. Abundant in rocky streams; F. 25th May.

Umbelliferæ (Parsley Family).

Sanicula Marilandica, Linn. Portage to Bark lake, Huckleberry rapids and amongst grass at Hamilton's Farm.

Cicuta bulbifera, Linn. Borders of a small lake near Hamilton's Farm and a muddy creek near Trembling Lake.

Sium lineare, Michx. Borders of a small lake near Hamilton's Farm.

Osmorrhiza brevistylis, DC. Common in open woods and round clearings.

Araliaceæ, (Ginseng Family.)

Aralia racemosa, Linn. (Spigot) Common in open places on alluvial soil; F. 20th July to 21st August, F. R., 7th September.

" hispida, Michx. Abundant in burnt clearings, Hamilton's

Farm, and on Trembling Mountain; F. R. 28th August.

Aralia nudicaulis, Linn. (Sarsaparilla.) Very abundant everywhere, except on sand, F. 13th June, F. R. 29th July.

' trifolia, Gray. Rocky woods, Sixteen Island Lake.

Cornaceæ, (Dog-wood Family).

Cornus Canadensis, Linn. Abundant in rocky woods; F. 20th June.

" circinata, L'Her. On limestone rocks, Huckleberry rapids.

" stolonifera, Michx. (Red Osier). In profusion on shores of the Rouge and Lakes; F. 30th June.

" alternifolia, Linn. (Green Withy). Sparingly on alluvial soil in woods.

Caprifoliaceæ, (Honey-suckle Family).

Linnæa borealis, Gronov. Very abundant in woods; F. 30th June.

Lonicera ciliata, Muhl. Abundant in rocky woods; F. 30th May, F. R. 30th June.

Diervilla trifida, Mœnch. Very abundant in open places on rocks and sand; F. 27th June.

Sambucus Canadensis, Linn. (Elder.) Round clearings and open places, on limestone and alluvial soil.

" pubens, Michx. Abundant in rocky woods; F. R. 17th July.

Viburnum Lentago, Linn. Not seen below Silver Mountain, but common there and everywhere above, especially on Trembling Mountain; F. R. 11 June.

" Opulus, Linn. (High-bush Cranberry.) Sparingly near water, Sugar-bush Lake, and banks of the Rouge near Silver Mountain; F. 25th June.

" lantanoides, Michx. (Mozo-mish, Algonquin. Welsh Hopple.) Very abundant, forming a large part of the underwood in rocky woods; F. 30th May.

Rubiaceæ, (Madder Family).

Galium asprellum, Michx. Abundant in low swampy ground.

" trifidum, Linn. Open sandy places, about clearings, &c.

" triflorum, Michx. Abundant in open sandy places, banks of the Rouge and Sugar-bush Lake.

Mitchella repens, Linn. (Ke-na-pe-ko-bug, Algonquin, Partridge berry.) In profusion in rocky woods; F. 17th July, F. R. 9th August.

Compositæ, (Composite Family).

Eupatorium purpureum, Linn. (Ka-bis-sak-wan-nith-que-ok, Algonquin). Abundant, reaching a height of six feet in swampy places, but much stunted when growing on rocks; F. 9th August.

Aster corymbosus, Ait. Abundant in lumber roads near Hamilton's Farm.

" macrophyllus, Linn. Common in rocky and sandy woods, and open places; F. 4th August.

Aster longifolius ? Linn. On sand at the base of Silver Mountain; F. 10th August.

" puniceus, Linn. Growing in dense clumps in swampy ground; F. 25th August.

" acuminatus, Michx. Common on rocks at Huckleberry Rapids and Silver Mountain, F. 9th August.

" nemoralis, Ait. In profusion on gneiss rocks on the shores of Trembling Lake; F. 7th September.

Erigeron Canadense, Linn. Open fields amongst grass, Hamilton's Farm.

" Philadelphicum, Linn. Moist clay bank of the Rouge, Arundel; F. 30th June.

" strigosum, Muhl. On sand at the mouth of the Devil's River, and common at Hamilton's Farm; F. 21st July.

Diplopappus umbellatus, Torrey and Gray. In great profusion on the sandy banks of the Rouge, and on the shores of lakes; F. August.

Solidago latifolia, Linn. Common on sandy banks by the water side; F. 12th August.

" (undetermined). Abundant everywhere along the Rouge on rocks and sand.

" altissima, Linn. (Golden-rod.) Very common on rocks and sandy banks of the Rouge.

" nemoralis, Ait. Abundant on sandy banks of the Rouge.

" lanceolata, Linn. Abundant on sandy banks of the Rouge.

* Achillea Millefolium, Linn. (Yarrow). Abundant on sandy banks of the Rouge; F. 21st July.

* Lucanthemum vulgare, Linn. In great abundance round clearings and on the banks of the Rouge.

* Tanacetum vulgare, Linn. About settlements in Grenville and Wentworth.

Gnaphalium polycephalum, Michx. Common in open places and very abundant at Hamilton's Farm, amongst grass in the fields.

Antennaria plantaginifolia, Hook. On gneiss rocks, Huckleberry Rapids, and on a small mountain near Silver Mountain.

* Cirsium lanceolatum, Scop. About clearings at Bevin's Lake, and Hamilton's Farm.

" muticum, Michx. Swamp near Hamilton's Farm; F. 2nd September.

* " arvense, Scop. (Canada Thistle). About clearings at Bevin's Lake and Hamilton's Farm.

Hieracium Canadense, Michx. Common on rocks and sand; F. 9th August.

Nabalus albus, Hook. Abundant on rocks and sand banks, in open places; F. 19th August.

* Taraxacum Dens-leonis, Desf. (Dandelion). Common near clearings and along portage paths.

Mulgedium leucophæum, DC. Common about clearings and open places on sandy soil.

Lobeliaceæ, (Lobelia Family).

Lobelia inflata, Linn. Common, lumber roads and open fields, Hamilton's Farm.

Ericaceæ, (Heath Family).

Vaccinum Oxycoccus, Linn. Tamarack swamp near Hamilton's Farm.

" macrocarpon, Ait. (Mas-ki-ki-min, Algonquin, Cranberry). Bog or Beaver Meadow near Indian Village, Arundel; F. 16th July.

" Canadense, Kalm. Abundant on gneiss rocks and in swamps; F. 15th June, F. R. 23d July.

Chiogenes hispidula, Torr. & Gray. (Indian Tea). Abundant in rocky and sandy woods and swamps, amongst moss; F. R. 25th August.

Epigæa repens, Linn. Common on sand and gneiss rocks amongst pines near Hamilton's Farm.

Gaultheria procumbens, Linn. (Low-bush Cranberry). Very abundant in woods and bogs, especially among young trees; F. August and September.

Cassandra calyculata, Don. Shores of lakes and in swamps; F. 18th May.

Andromeda polifolia, Linn. Tamarack swamp in Wentworth and near Indian Village; F. 13th June.

Kalmia angustifolia, Linn. (Wi-sa-ke-bug, Algonquin). On gneiss rocks and in swamps; F. 17th July.

Ledum latifolium, Ait. (Labrador Tea). Abundant on gneiss rocks and swamps in open places; F. 20th June.

Pyrola rotundifolia, Linn. (Ka-kis-ke-bok). Abundant, especially at Huckleberry Rapids, amongst young poplars; F. 23rd July.

" secunda, Linn. Common in rocky woods; F. 9th July.

Chimaphila umbellata, Nutt. (Prince's Pine). Abundant in open pine woods; F. 23rd July.

Monotropa uniflora, Linn. (Anay-moos-she-moos-ki-ki, Algonquin, said to mean the little-dog's-pipe). Common in woods, especially on rocky hills; F. 25th July to 11th September.

" Hypopitys Linn. Occasionally met with in damp woods; F. 7th July to 20th August.

Aquifoliaceæ, (Holly Family).

Ilex verticillata, Gray. On gneiss rocks and swamps in open places; F. 17th July, F. R. 7th September.

Nemopanthes Canadensis, DC. (Mau-ko-ke-me-che, Algonquin). Common on gneiss rocks, and in swamps; F. R. 16th August.

Plantaginaceæ, (Plantain Family).

* Plantago major, Linn. Abundant about Hamilton's Farm.

Primulaceæ, (Primrose Family).

Trientalis Americana, Pursh. (Ground Cherry). Abundant almost everywhere; F. 25th June.

Lysimachia stricta, Ait. Very abundant by water side, in low place all along the Rouge; F. 7th August.

Lentibulaceæ, (Bladder-wort Family).

Utricularia vulgaris? Linn. Abundant in a small lake near Hamilton's Farm.

Scrophulariaceæ, (Fig-wort Family).

* Verbascum Thapsus, Linn. Clearings near Indian Village and Hamilton's Farm; F. 16th July.

Chelone glabra, Linn. Common on sand banks by water side, and in swamps; F. 16th August.

Mimulus ringens, Linn. Shores of the Rouge near Thompson's clearing.

Ilysanthes gratioloides, Benth. In great abundance on exsiccated places, Hamilton's Farm.

Veronica scutellata, Linn. On sand, in a few places, by side of the Rouge.

Labiateæ, (Mint Family).

Mentha Canadensis, Linn. Abundant in low places along the Rouge; F. 9th August.

Lycopus Virginicus, Linn. In profusion on sand by water side and on rocks; F. 5th August.

Brunella vulgaris, Linn. Common about clearings and lumber roads; F. 18th July.

Scutellaria galericulata, Linn. Abundant everywhere along the Rouge, and low places by streams; F. 9th August.

" lateriflora, Linn. Equally abundant with the last species in the same places.

* Galeopsis Tetrahit, Linn. Abundant about clearings near Devil's Rapids and Hamilton's Farm.

Borraginaceæ, (Borage Family).

* Cynoglossum officinale, Linn. A little in open places, Huckleberry Rapids.

Gentianaceæ, (Gentian Family).

Gentiana Andrewsii, Griseb. Common on sand by sides of the Rouge, shores of lakes and swamps; F. 5th August to 11th September.

Menyanthes trifoliata, Linn. Bog near Indian Village, Arundel.

Apocynaceæ, (Dog-bane Family).

Apocynum androsæmifolium, Linn. Common in open sandy places and on rocks; F. 10 July.

" cannabinum, Linn. Abundant on sand banks by the side of the Rouge; F. 18th July.

Asclepiadaceæ, (Milk-weed Family).

Asclepias incarnata, Linn. (To-to-cha-na-bo-wakn, Algonquin). Exsiccated places near Indian Village; F. 18th July.

Oleaceæ, (Olive Family).

Fraxinus Americana, Linn. (White Ash). Abundant in woods, reaching a large size especially on drift; bare of leaves 7th October.

" sambucifolia, Linn. (Black Ash). Common in low ground by water side.

Aristolochiaceæ, (Birthwort Family).

Asarum Canadense, Linn. (Wild Ginger). In a few places on low sandy flats.

Chenopodiaceæ, (Goose-foot Family).

* Chenopodium album, Linn. (Lamb's Quarters). Abundant about the Indian Village and Hamilton's Farm.

Polygonaceæ, (Buck-wheat Family).

* Polygonum Persicaria, Linn. Abundant about the house at Hamilton's Farm.

" aviculare, Linn. Abundant with the last species.

" sagittatum, Linn. Damp places in woods near Hamilton's Farm.

" cilinode, Michx. Common, open places, borders of woods, &c.

Rumex —— ? I observed a tall Dock growing by the side of the Rouge near Silver Mountain but was unable to obtain a specimen.

* " Acetosella, Linn. (Sheep's Sorrel.) Abundant about clearing and old portage paths.

Thymeleaceæ (Mezereum Family.)

Dirca palustris, Linn. (Che-ba-cub, Algonquin;) Moose-wood. Abundant in woods on all soils; F. 22d May.

Urticaceæ (Nettle Family.)

Ulmus Americana, Linn. (White Elm.) Abundant and reaching a large size on gneiss, limestone and drift.

Laportea Canadensis, Gaudich. Growing in dense beds on low alluvial soil; F. 1st July.

Juglandaceæ (Walnut Family.)

Juglans cinerea, Linn. (Butternut.) Abundant on sandbanks near the Indian Village and Sugar Bush Lake.

Cupuliferæ. (Oak Family.)

Qercus alba, Linn. (White Oak.) Some very fine trees at Sugar-bush and Bevin's Lakes, Montcalm, on alluvial soil.

Fagus ferruginea, Ait. (Beech.) Generally distributed through the woods, but most abundant on gneiss forming splendid Beech Woods in the Township of Wentworth.

Corylus rostrata, Ait. (Wild Nut.) Abundant in moist open places.

Ostrya Virginica, Willd. (Iron wood.) Sparingly on alluvial soil Sugar-bush and Bevin's Lakes.

Myricaceæ (Sweet-gale Family.)

Myrica Gale, Linn. Abundant on the shores of Lakes and in Swamps; F. 24th May.

Betulaceæ (Birch Family.)

Betula papyracea, Ait. (Canoe Birch.) Numerous in some places along the Rouge above the Indian Village and sparingly distributed through the woods, being seldom of large size.

" excelsa, Ait. (Yellow Birch.) Abundant and generally distributed.

Alnus incana, Willd. (Alder.) Forming dense thickets on the shores of all the rivers and lakes. Very tall on rocks at Huckleberry Rapids.

Salicaceæ (Willow Family.)

Salix candida? Willd. A little on alluvial soil, Sugar-bush Lake.

" discolor, Muhl. Sugar-bush Lake, Montcalm and Mouth of Devil's River.

" sericea, Marshall. Mouth of Devil's River on sand.

" longifolia. Muhl. Sugar-bush Lake, common.

" lucida, Muhl. Banks of the Rouge, abundant.

Populus tremuloides, Michx. (Aspen.) Grows to a large size on alluvial soil and is common.

" grandidentata, Michx. (Common Poplar.) Forms with the last species and white birch dense thickets of young trees where other trees have been removed, grows to a good size in some places.

" balsamifera, Linn. (Balsam Poplar.) A few fine trees at Sugar-bush Lake and small bushes up Devil's River and Huckleberry Rapids.

Coniferæ (Pine Family.)

Pinus resinosa, Ait. (Norway Pine.) On limestone and gneiss islands, Trembling Lake, and gneiss ridge; Lake of Three Mountains,

" Strobus, Linn. (White Pine.) The greater part of the White Pine of any size has been removed in this district, but a few pine trees are scattered here and there on all kinds of soil. Numerous at Hamilton's Farm on sand, small trees are numerous on gneiss hills.

Abies balsamea, Marshall. (Balsam Fir.) Not very abundant, on sand.

" Canadensis, Michx. (Hemlock.) Abundant, reaching a large size, and often growing on bare rocks.

" alba, Michx. (Spruce.) Very abundant on gneiss hills and sand.

Larix Americana, Michx. (Tamarack.) Forms extensive "tamarack swamps," and scattered trees are found in every variety of situation.

Thuja occidentalis, Linn. (Cedar.) Forming extensive "cedar swamps, and pinging the shores of all lakes.

Taxus baccata, Linn. var. Canadensis (Ground Hemlock.) Abundant, especially in low sandy woods.

Araceæ (Arum Family.)

Arisæma triphyllum, Torr. (Indian Turnip.) Common in moist woods; F. 2d June.

Acorus Calamus, Linn. Sandy banks of the Rouge.

Typhaceæ (Cat-tail Family.)

Typha latifolia, Linn. Up the Devil's River in one place only.

Sparganium simplex, Hudson. Muddy creek near Huckleberry Rapids; F. 31st July.

Naiadaccæ (Pondweed Family.)

Potamogeton (undetermined.) Abundant in the Rouge, in quiet places.

Alismaceæ (Water-plantain Family.)

Sagittaria variabilis, Engelm (Mo-sa-ka-ta-mo, Algonquin; Arrow-head.) Abundant in muddy creeks and lakes, and along the Rouge; F. 29th July.

Orchidaceæ (Orchis Family.)

Platanthera orbiculata, Lindl. (Heal-all.) Abundant in woods; F. 3rd. July.

" dilatata? Lindl. Observed in several places in the woods; F. 15th July.

" fimbriata, Lindl. Abundant in low swampy grounds; F. 19th July.

Goodyera pubescens, R. Brown. Abundant in rocky and sandy woods; F. 20th August.

Pogonia ophioglossoides, Nutt. Numerous in bogs near Indian Village; F. 16th July.

Calopogon pulchellus, R. Brown. Numerous in bogs near Indian Village; F. 16th July.

Microstylis ophioglossoides, Nutt. Dry hills, Huckleberry Rapids.

Cypripedium pubescens, Willd. (Moccason Flower.) Near Lake St. Jean, Wentworth; F. 13th June.

" acaule, Ait. On gneiss rocks and sand, common; F. 16th June.

Iridaceæ (Iris Family.)

Iris versicolor, Linn. Abundant, shores of the Rouge and lakes; F. 26th June.

Smilaceæ (Smilax Family.)

Smilax herbacea, Linn. Mouth of the Devil's River, on sand, climbing over bushes.

Trillium erectum, Linn. Abundant in rocky woods; F. 18th May.

" var. album, Purch. On limestone, between Gate and Gut Lakes, Wentworth.

" grandiflorum, Salisb. Townships of Grenville and Wentworth, not seen beyond Gate Lake; F. 25th May.

" erythrocarpum, Michx. Abundant in rocky woods; F. 31st May.

Medeola Virginica, Linn. Very abundant in rocky and sandy woods; F. 21st June, F. R. 2d September.

Liliaceæ (Lily Family.)

Polygonatum biflorum, Ell. Common in moist woods; F. 29th May.

Smilacina racemosa, Desf. (Au-que-co-ce-wa, Algonquin, meaning Chip-nambo berries.) Abundant in rocky woods; F. 19th June.

" stellata, Desf. On sand by water-side, not common; F. 20th June.

Clintonia borealis, Raf. Very abundant everywhere in woods; F. 16th June.

Allium tricoccum, Ait. (Chi-kwa-kwich, Algonquin, said to mean it makes a bad smell.) Abundant in moist places in woods; F. 17th July.

Erythronium Americanum, Smith. Abundant in rich woods; F. 22d May.

Melanthaceæ (Colchicum Family.)

Uvularia grandiflora, Smith. Abundant by road-sides in cleared parts of Grenville; F. 14th May.

Streptopus amplexifolius, DC. In great abundance in moist places in woods; F. 2d July.

" roseus, Michx. (Squaw-root.) Abundant in rocky woods; F. end of May.

Juncaceæ (Rush Family.)

Juncus articulatus, Linn. Abundant on sandy banks of the Rouge.

" tenuis, Willd. Hamilton's Farm.

" bufonius, Linn. Hamilton's Farm.

Pontederiaceæ (Pickerel-weed Family.)

Pontederia cordata, Linn. Very abundant in small lakes near Lake of Three Mountains and in sheltered shallow parts of Trembling Lake.

Eriocaulonaceæ (Pipewort Family.)

Eriocaulon septangulare? Withering. Trembling Lake, Lake of Three Mountains, &c.

Cyperaceæ (Sedge Family.)

Dulichium spathaceum, Pers. Swampy ground near Hamilton's Farm.

Eleocharis palustris, R. Brown, (Spike-rush.) In pools of water on rocks, Huckleberry Rapids.

Scirpus sylvaticus, Linn. var. atrovirens (Bulrush.) Abundant sandy banks of the Rouge.

" Eriophorum, Michx. In pools of water on rocks, Huckleberry Rapids.

Eriophorum Virginicum, Linn. (Cotton grass.) Boggy margins of small lakes near Hamilton's Farm.

Carex tenella, Schk. Abundant, growing in water, Sugar-bush Lake, Montcalm.

" scoparia, Schk. Abundant, on sandy banks of the Rouge.

" festucacea, Schk. Sandy banks of the Rouge and Bevin's Lakes, Arundel.

Carex crinita, Lam. Abundant in moist places and borders of streams in woods.
" pedunculata, Muhl. In rich woods on limestone between Gate and St. Jean Lakes, Wentworth.
" arctata, Boott. On alluvial soil, Sugar-bush Lake, Montcalm.
" lacustris, Willd. With the last species.
" intumescens, Rudge. With the two last species.
" retrorsa, Schw. Sugar-bush and Bevin's Lakes, Montcalm.

Gramineæ (Grass Family.)

*Phleum pratense, Linn. (Timothy.) Abundant round clearings and sandy banks of the Rouge.
Agrostis perennans, Tuckerm. Sandy banks of the Rouge.
" vulgaris, With. (Red-top grass.) Everywhere in open places and about clearings.
Cinna arundinacea, Linn. var. pendula. Sandy banks of the Rouge.
Muhlenbergia Mexicana, Trin. Abundant on sandy banks of the Rouge.
Calamagrostis Canadensis, Beauv. Abundant about the Indian Settlement and in open places.
Poa serotina, Ehrh. Open places, Huckleberry Rapids.
" pratensis, Linn. (Common Meadow-grass.) Abundant about Indian Village and other clearings.
Bromus ciliatus, Linn. Abundant, sandy banks of the Rouge, and in moist woods.
Elymus Canadensis, Linn. In moist places along lumber roads.
Milium effusum, Linn. On alluvial soil, Sugar-bush Lake, Montcalm.
Panicum microcarpon, Muhl. On sand banks, sides of the Rouge.
" pauciflorum, Ell.? Huckleberry Rapids.
" depauperatum, Muhl. Huckleberry Rapids.

Equisetaceæ (Horse-tail Family.)

Equisetum pratense, Ehrh. Abundant, wet sandy banks of the Rouge.
" sylvaticum, Linn. With the last species.
" limosum, Linn. Abundant in shallow water at the mouths of creeks and sides of the Rouge.
" hyemale, Linn. Sparingly in numerous localities throughout the district, common at Hamilton's Farm.
" scirpoides, Michx. Amongst mosses on gneiss rocks in woods.

Filices (Ferns.)

Polypodium vulgare, Linn. Principally on gneiss rocks, very abundant.
" Phegopteris, Linn. Very abundant in damp woods.
" Dryopteris, Linn. Abundant in rocky woods.
Struthiopteris Germanica, Willd. Abundant in low swampy ground in woods.

Allosorus gracilis, Presl. On crystalline limestone near the Lake of Three Mountains.

Pteris aquilina, Linn. Abundant amongst White Pine and in open places.

Adiantum pedatum, Linn. In small patches on limestone and garnetiferous gneiss.

Asplenium thelypteroides, Michx. Rare. In rich woods, De Salaberry West Town Line.

" Filix-fœmina, R. Brown. Very abundant in moist woods.

Dicksonia punctilobula, Hook. Abundant in damp woods, in Harrington, and near Hamilton's Farm.

Woodsia Ilvensis, R. Brown. On rocks on a hill, near Silver Mountain.

Cystopteris bulbifera, Bernh. Abundant on damp limestone rocks in woods near Huckleberry Rapids, and Lake of Three Mountains.

" fragilis, Bernh. On gneiss rocks, base of Silver Mountain, and near Lake of Three Mountains.

Aspidium Thelypteris, Swartz. Damp woods.

" spinulosum, Swartz. Everywhere abundant.

" cristatum, Swartz. Bevin's Lake, Lake of Three Mountains, and near Hamilton's Farm.

" Goldianum, Hook. Abundant amongst gneiss rocks, near Hamilton's Farm.

" marginale, Swartz. Abundant on gneiss rocks everywhere.

" aculeatum, Swartz, var. Braunii, Koch. Abundant on gneiss rocks and on damp logs.

" acrostichoides, Swartz. Sparingly in various localities.

Onoclea sensibilis, Linn. In dense patches in low swampy ground.

Osmunda regalis, Linn. var. spectabilis. Abundant, borders of streams, and swampy places.

" Claytoniana, Linn. Abundant in swampy places.

" cinnamomea, Linn. Swampy places near Bevin's Lake.

Botrychium Virginicum, Swartz. Abundant in open places, Huckleberry Rapids and Hamilton's Farm.

Lycopodiaceæ (Club-moss Family.)

Lycopodium lucidulum, Michx. Sixteen Island Lake.

" dendroideum, Michx. Abundant in rocky woods.

" clavatum, Linn. Abundant in rocky and sandy woods.

" complanatum, Linn. Common in woods.

Musci (Mosses.)

Sphagnum cymbifolium, Dill. Forming the bogs called Beaver-meadows.

" acutifolium. Ehrh. On gneiss rocks in open places.

Dicranum interruptum, Br. and Sch. On boulders near Bevin's Lake.

" scoparium, Linn. On gneiss rocks on a small mountain near Silver Mountain.

" Drummondii, Mull. Near Sugar-bush and Balsam Lakes Montcalm.

Dicranum Scottianum, Turn. (Fert.) Sixteen Island Lake, Montcalm.

Leucobryum glaucum, Hampe. In large clumps on gneiss rocks amongst pines. Sixteen Island Lakes.

Polytrichum commune, Linn, (Fert.) Abundant in wet places and on moist rocks.

" formosum, Hedw. Near Chain Lake, Montcalm.

" juniperinum, Hedw. (Fert.) Near Chain Lake, Montcalm, and on gneiss hills on the Rouge.

Bryum roseum, Schreb. Abundant everywhere in woods.

" Wahlenbergii, Schreb. (Fert.) Wet clayey places in woods and clayey banks of the Rouge, Arundel, 30 Tune.

Mnium affine, Bland. On decayed logs near Chain and Sugar-bush Lakes, Montcalm.

" hornum, Hedw. Chain Lake, Montcalm and Huckleberry Rapids, De Salaberry.

" orthorhynchum, Brid. (Fert.) Huckleberry Rapids, De Salaberry, July.

" punctatum, Hedw. Abundant in streams and wet places.

" Drummondii, Br. and Sch. (Fert.) On limestone between Gut and Gate Lakes, Wentworth.

" spinulosum, Bry. Europ. Near chain Lake, Montcalm.

Bartramia pomiformis, Hedw. (Fert.) Abundant on both gneiss and crystalline limestone rocks, near Lake of Three Mountains.

" fontana, Brid. On limestone rocks near water, Huckleberry Rapids.

Funaria hygrometrica, Hedw. (Fert.) On rocky places which have been burnt over; in great abundance.

Fontinalis Frostii, Sulliv. Abundant in a stream running into Sixteen Island Lake.

Dichelyma capillaceum, Bry. Europ. On dead sticks in water Sugar-bush Lake.

Anomodon obtusifolius, Br. and Sch. Abundant everywhere on trunks of trees.

Platygyrium repens, Bry. Europ. On tree trunks, decayed logs, &c. Sugar-bush Lake.

Neckera pennata, Hedw. (Fert.) Abundant on trunks of growing cedars.

Climacium Americanum, Brid. Abundant in wet places in woods.

" dendroides, Web. and Mohr. By the sides of streams in woods, Montcalm.

Hypnum triquetrum, Linn. (Fert.) Everywhere in woods on the ground and fallen trees.

" splendens, Hedw. Very abundant with the last species.

" Schreberi, Willd. Abundant in woods on gneiss hills.

" fluitans, Linn. Bevin's Lake, Montcalm.

" Crista-Castrensis, Linn. Very abundant in damp woods.

Hypnum reptile, Michx. (Fert.) Mixed with *Platygyrium repens* on decayed logs, &c., Sugar-bush Lake.

" curvifolium, Hedw. (Fert.) Sugar-bush Lake, &c., Montcalm.

" Haldanianum, Grev. On boulders, near Bevin's Lake, Montcalm.

" rutabulum, Linn. Chain Lake, Montcalm.

Hepaticæ (Liverworts.)

Marchantia polymorpha, Linn. (Fert.) Everywhere round burnt clearings on the ground.

Fegatella conica, Corda. In damp woods on mosses, Sugar-bush Lake, and on limestone rocks in woods near Huckleberry Rapids.

Jungermannia —— ? Abundant on tree trunks.

Trichocolea Tomentella, Nees. Hamilton's Farm.

Lichenes (Lichens.)

Usnea barbata, Fr. var. pendula. Everywhere hanging from the branches of the conifers.

Petigera aphthosa, Hoffm, (Infert and Fert.) Pine woods near Thompson's clearing.

" polydactyla, Hoffm, (Fert.) Common in woods on mosses

Sticta pulmonaria, Ach. (Tripe-de-Roche.) Pine woods, near Thompson's clearing.

Parmelia caperata, Ach. Abundant on trunks of pine and stones.

Cladonia pyxidata, Fr. (Fert.) (Cup-lichen.) Abundant on stumps and decaying trees.

" gracilis, Fr. (Fert.) (Red cup-lichen.) Everywhere on decaying logs and stumps.

" furcata, Floerk. (Fert.) Pine woods near Thompson's clearing.

" rangiferina, Hoffm. (Rein-deer Moss.)

" " var. sylvatica Fl. On a gneiss hill in woods.

" " var. alpestris, Fl. Abundant on rocks in open places.

Umbilicaria hirsuta, Ach. On a gneiss hill near Silver Mountain.

Agaric.

Clavaria (probably C. fragilis. Destroyed in drying.) Very abundant, covering the ground for many yards, September 18th., woods near Lake of Three Mountains.

Note.—This Catalogue was completed in the summer of 1859, and a copy containing much more elaborate notes than those above, which I transmitted for publication at the beginning of February last by the Steamer "Hungarian," was lost on board that unfortunate vessel.

London, May 16, 1860.

ARTICLE IX.—*Notes on the Geology of Murray Bay—Lower St. Lawrence.* By J. W. DAWSON, LL.D., F.G.S.

(Read before the Natural History Society.)

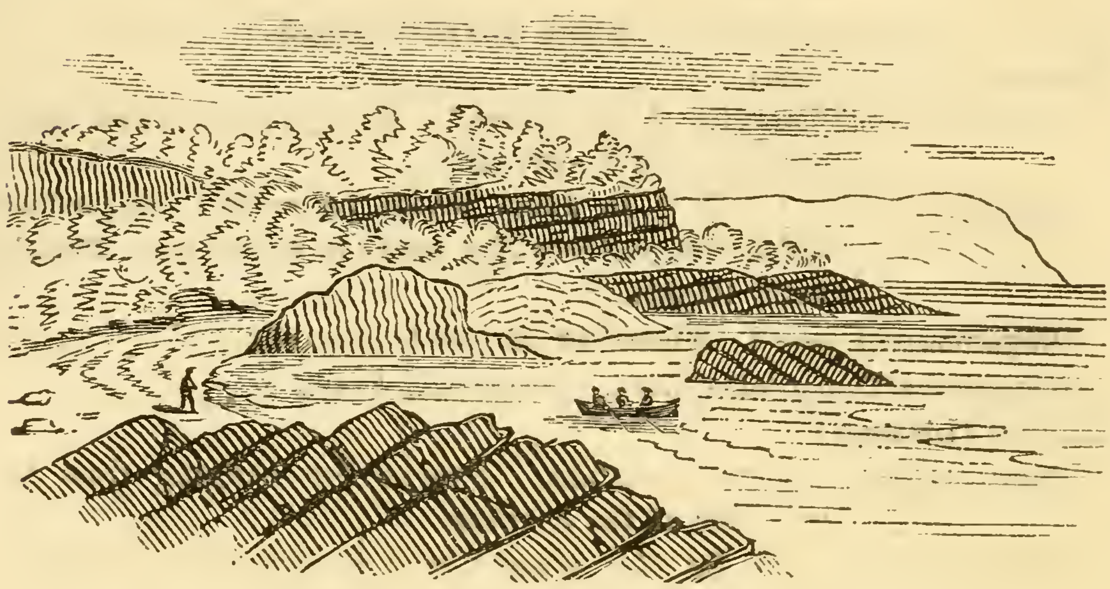


Fig. 2.
Coast near L'Ecorché. See p. 141.

Murray or Mal Bay on the north side of the River St. Lawrence, and about 90 miles below Quebec, is well known as a place of resort to summer tourists and sea bathers, and has not been unvisited by geologists. In 1822, Dr. Bigsby, one of the earliest explorers of Canadian geology, and still in his green old age a prominent member of the Geological Society of London, spent a few days at this place, and published a most interesting and graphic account of its topography and geology, in Silliman's American Journal.* In 1831, Capt. Baddely published in the Transactions of the Literary and Historical Society of Quebec, an account of the neighbouring Bay of St. Paul, with a notice of the earthquakes which appear to visit this district more frequently than any other part of Canada.† In 1849 the steps of our Provincial geologist were directed thither, in consequence of a fabulous report of the discovery of coal at Bay St. Paul; and a short but clear and accurate account of the structure of this part of Canada appeared in the Report of the Survey for that year. Learning from these previous observers, that the locality is of much geological interest, I determined in visiting it for a few days in the past summer, to pick up such gleanings as my prede-

* Vol. 5, 1822.

† Quebec Transactions, vol. II. See also paper by the author on the earthquake of 1860. Can. Nat., vol. 5.

cessors might have left, and in this I was greatly aided by one of my students, Mr. R. Ramsay of Montreal, who happened to be spending his vacation there.

The features of the place have been admirably described by Dr. Bigsby and Sir W. E. Logan, so that a very few remarks on this subject may suffice here. In approaching the bay from the west, the voyager passes along the base of lofty cliffs crowned by forests and broken by a few wooded ravines, down which little brooks dash to the shore. Near the termination of this wall of cliffs, and at the base of a steep ascent leading to a gap separating the last outlier of rock from the main mass, stands the steamboat pier. Ascending the rising ground above the pier, and passing to its northern side, one sees in the foreground a row of cottages extending along the western side of the bay, whose waters at high tide rise close to the low bank, and when they recede leave an immense flat of sand and boulders, across which stretch the long brush weirs of the fishermen. Beyond are seen the sides of the bay rising into terraced hills and converging toward the mouth of the Murray Bay River, where concealed by trees are the church and village of Mal Bay ; and still farther the eye can trace the deep valley of the river winding among high wooded hills, that rise one over another in the blue distance. It is a beautiful spot, well worthy of taking a leading place among the summer resting places of our worn and wearied citizens.

The general geology of Murray Bay may be thus sketched. The higher hills consist of rocks of the *Laurentian System*, the oldest strata known to geologists; and in some places as at the high cliffs before mentioned, and at Cape Heu on the opposite side of the bay, these come boldly down to the shore. In other places the coast cliffs and reefs are *Lower Silurian*, and abound in marine fossils, and these beds in some places mantle the hills to a considerable height, and run a long way up the valley of the river. The terraces of sand and gravel along the sides of the bay, and the deep clay of the river valley, are of *Post Pliocene* date, and contain shells identical in species with those now living in the Gulf of St. Lawrence. I shall notice these formatione in their order.

1. *Laurentian System.*

These venerable rocks, ancient above all others, are admirably exposed in the coast cliffs above mentioned, and in several other

places in the vicinity of the bay, but they present a strange and puzzling aspect to the observer. Proved by the investigations of Logan and Hunt, to have once been sedimentary rocks, they have been so changed by heat and chemical action, that they retain no resemblance to the sands, clays, and limestones, of which they were originally composed. They now appear as beautifully crystalline layers, which have when in a yielding and flexible condition, been bent and crumpled as if for long ages they had been kneaded by the hands of Titans, so that it is difficult to form any conception either of their original nature or arrangement. The greater number of rocks are eloquent to the geologist of the history of life in past periods of the earth, but these Laurentian beds preserve an obstinate silence, only hinting in their flakes of graphite and their crystalline limestones, that they have a story which they cannot be persuaded to tell. Still they afford very instructive examples of the changes which may be effected by metamorphism in aqueous sediments, and they abound in interesting and curious crystallized minerals. In the high cliff commencing immediately west of the pier, they are well exposed; and at this place the order of succession is as follows, apparently in ascending order, though these beds are here so often inverted that little reliance can be placed on apparent superposition.

1. Gneiss of various colours and qualities, with both lime and potash felspars, and containing beds of mica slate, with large nodules of garnet, around which the beds bend as if the garnets had originally been foreign masses or pebbles. In some places these beds hold bands or dykes of a coarse-grained red felspar. These gneissose beds are of great thickness and occupy the greater part of this long range of cliffs. They reappear on the opposite side, at and beyond Cape Heu.

2. White quartz rock, perfectly compact, with thin bands of hornblendic and micaceous schist, and in the upper part with some crystals of flesh-coloured felspar. This bed or a similar one appears on the opposite side of the bay on both sides of Cape Heu, where in one place it immediately underlies the Silurian beds, as has been observed by Sir W. E. Logan, but it is clearly a member of the Laurentian series.

3. Impure crystalline dolomite, and light-coloured laminated serpentine. These are only a few feet in thickness, and in some places seem reduced to a few inches. Being the softest part of these rocks, they form a depression in the cliff or reef, and are often hidden by gravel or rubbish.

4. Gneiss as before.

5. Black hornblendic slate with films of mica on the planes of cleavage or bedding.

On the opposite side of the bay the gneiss rises into the high and rugged promontory of Cape Heu, in which a great thickness of this rock is exposed, presenting a succession of hard angular ridges, and having its strike nearly in the direction of the shore or S. 25° W. (see Fig. 1). Cape Heu rises through Silurian limestones which appear on both sides of it and inland. On the west side after an interval occupied by the Silurian beds, the gneiss reappears with a high dip to the N. W., and containing thick veins of red felspar. In tracing it along the shore it becomes nearly horizontal,

W Fig. 1. E

(a) *Silurian.* (b) *Laurentian.*

and then dips to the north, and finally becomes vertical and much contorted. Here it contains a vein or bed of coarse grained granite. Next appear mica and hornblende slates, the former with garnets and having a strike S. 20° W. to S. 30° W: then after a space of 150 yards without section, white quartz rock 45 feet thick, and in a vertical position, and succeeding this gneiss with bands apparently of crystalline limestone 4 feet, coarse crystalline dolomite and serpentine 10 feet, and gneiss 4 feet; after which these rocks are concealed by the Silurian beds, resting on them unconformably.

Westward of Cape Heu the quartz rock again appears, and seems here to overlie the gneiss, and no other beds appear between it and the Silurian rocks, which here appear in great mass, forming the conspicuous cliff of L'Ecorché. West of this, and toward Cape Baleine, the shore runs nearly in the junction of the Laurentian and Silurian, the alternate appearance of which at the several points and capes, gives a confused appearance to the coast section, increased by the fact that the Silurian beds are bent into an anticlinal fold near the junction, and that dislocation and denudation have moulded the Laurentian into such irregular forms. Fig. 2 represents a portion of the shore looking east. The Silurian rocks are shaded and appear in the foreground, in a reef dry at low water, and in the cliff of L'Ecorché. The Lauren-

tian forms irregular masses in the middle ground, and Cape Heu presents its bold front in the distance.

2. *Silurian System.*

These rocks rest unconformably on the old gnarled Laurentian beds, and are here sandy in the lower part, simulating the appearance of the Potsdam sandstone, seen in a similar position further west. A little higher they assume the aspect of Calcareous sandstones, and these are overlaid by limestones capped by dark calcareous shales. We thus have a series which at first sight might be supposed to be a miniature representation of the whole lower Silurian of Canada, from the Potsdam sandstone to the Utica slate. According to Mr. Billings, however, the fossils of these beds belong to the middle part of this series, between the Chazy limestone and Trenton limestone, so that here the older members of the Lower Silurian series either do not occur or are represented only by a few feet of sandstone, nearly destitute of fossils. This corresponds with a conclusion arrived at by Sir William Logan, as the result of very extensive observation, that in the early part of the Silurian period, the old Laurentian shore running along the north of Canada was sinking beneath the sea, which was gradually carrying the newer deposits further and further up its sides, so that the older beds are often concealed from view. The subsidence must have been greater in some places than in others, or the upper deposits have in some places been more removed by subsequent denudation, for while in the middle of Canada near the confluence of the Ottawa, the series is complete, both to the westward and eastward the older members of the Silurian series are concealed. I was much struck with this lately at Madoc in Upper Canada, where the junction of hard slaty rocks of the Laurentian series with a Lower Silurian limestone is well seen. The latter under the limestone presents a shattered and weathered surface that must have long endured the action of the elements. while the limestone, a mass of fragments of shells and corals, contains irregular fragments of the older rock, and has filled up the crevices of the latter with whole and broken Orthoceratites, and other shells, which lie just as the wave threw them in. It requires scarcely any imagination in such a place to fancy one's self standing on the old Laurentian shore, and watching the bright billows hurling their load of shells and fragments against the shore, and year by year reaching higher and higher on the land,

and covering more and more of it with the spoils of the sea. In such a place the geologist longs to find some indication of the inhabitants of that early land. What trees rustled in the breezes that blew over that ancient sea? What animals roamed along the coast to feed on the dead cuttle-fishes as they were thrown on shore? No fragment of leaf or bone has yet told any tale of them. To find such remains would be a strange and startling discovery. Not to find them, is in some sense stranger still, for with so long a range of Lower Silurian shore as exists in Canada, it almost implies that the old Laurentian land was void and desolate, that in penetrating backward into geological time, we have reached a land and a period in which no creative fiat had gone forth to people the dry land. But we must not yet believe this on merely negative evidence, and must still search for the remains of such primeval life.

But to return to Murray Bay, the Silurian rocks are well seen at L'Ecorché, the section at which place has been given in some detail by Sir W. E. Logan. They are repeated on the coast east of Cape Heu, and are also seen on the west side of the bay inside the pier, near Little Mal Bay, and in various places on the hill sides, and on the Murray Bay River. From all these exposures, the following series of beds may be ascertained. The names of the fossils are given as determined by Mr. Billings, who has kindly examined them, and the series is descending.

I. Black bituminous flaggy limestone and shale, not rich in fossils. This is best seen at the cove east of Pt. Heu, and in places on the west side of the bay. The following fossils were collected, principally at the former place, *Orthis testudinaria*, *Conularia trentonensis*, *Discina*, n. s., *Serpulites*, n. s., *Graptolithus*, *Straparollus*, *Orthoceras*.

II. Gray and black limestone in thin uneven layers, and often coarse and sandy. It abounds in fossils and is well exposed some distance east of Cape Heu, also in the cliff at L'Ecorché, and in various places on the west side of the bay. The following fossils were collected. They are mostly species characteristic of the Trenton limestone.

Stenopora fibrosa.
Receptaculites Neptuni.
Glyptocrinus.

Orthis pectinella.

Bellerophon bilobatus.
Murchisonia.
Orthoceras Murrayi.
Cyrtoceras?

Strophomena alternata.
Leptaena sericea.
Ambonychia radiata.
Modiolopsis nasuta.
Cyrtodonta, n. s.
Trinucleus concentricus.
Asaphus platycephalus.
Bronteus lunatus.
Calymene Blumenbachii.
Encrinurus.
Dalmanites.

III. Hard arenaceous limestone and calcareous sandstone. This forms the greater part of the cliff at White Point, immediately within the pier, and the lower part of the high cliff at L'Ecorché. It is less distinctly seen east of Cape Heu. The sand in these beds is beautifully rounded as if by long attrition on the shore, and occasionally there are pebbles giving some beds the character of conglomerate. The following fossils were found, but the hardness of the beds rendered it impossible to procure perfect specimens.

Stenopora fibrosa.
Columnaria alveolata.
Petraia.
Glyptocrinus.
Vanuxemia Montrealensis.
Pleurotomaria staminea.
P————————
Orthoceras Bigsbyi.
O———— recticameratum.
Illaenus globosus.

IV. Thin bedded and somewhat nodular dark gray limestone. Best seen at L'Ecorché ; also east of Cape Heu, and in the cliff inside the pier, at the base near the west side. This bed abounds in *Leperditia*, apparently *L. amygdalina* and another species. It also contains *Strophomena alternata*, *Modiolopsis nasuta*, and a *Pleurotomaria*.

V. Hard gray quartzose sandstone with calcareous cement and bands of coarse sandy limestone. At L'Ecorché, also east of Cape Heu, in the cliff inside the pier, and at Little Mal Bay on the beach. The fossils are

Tetradium fibratum.
Lingula eva. N. s.
Rhynconella.
Pleurotomaria.
Murchisonia.

VI. Soft gray and dark gray laminated sandstone, seen at most of the places above mentioned. The gap through which the road passes upward from the pier, has been excavated in these soft beds. In the lower part of these beds there appears in one or two places a layer of coarse calcareous sandstone, holding fragments of the Laurentian quartz rock. This lowest bed at Pt. Baleine contains large specimens of *Orthoceras*, probably *O. Bigsbyi*. The soft sandstones abound in cylindrical marks, seemingly casts of worm tracks. They also contain fragments of carbonaceous matter, probably the remains of sea weeds. The only shells found in them were small fragments of *Lingula*, and a little *Pleurotomaria*, which may either belong to a new species or be a young individual of one already known.

The following is a detailed section of the lower part of the above series as it occurs in the east side of L'Ecorché. The order is *ascending*, or the reverse of that in the foregoing general summary.

Laurentian Series.—The upper part of this, at this place, is the quartz rock before mentioned, with a high dip to the westward. It rests on gneiss, and in the bank or cliff is seen to have the Silurian beds unconformably superimposed.

Silurian Series.—These dip W. 10° N., or nearly in the same direction with the Laurentian rocks, at an angle of 10°, and consist of the following beds:—

	ft.	in.
(1.) Gray and dark gray sandstone with worm burrows, thickness estimated	12	0
(2). Flaggy calcareous sandstone with a dark bed containing fucoids ? at top	5	0
(3.) Softer sandstone with dark coloured bands, very fucoidal in upper part	4	6
(4.) Hard calcareous sandstone	2	0
(5.) Coarse sandy limestone light gray, with many large *Lingulae* (*L. eva*, Billings) and *Tetradium*	0	4
(6.) Gray and dark sandstone with worm burrows and fucoids ; *Murchisonia*, *Tetradium* and *Pleurotomaria*	7	0
(7.) Hard gray sandstone divisible into thin flags	2	0
(8.) Thick bedded calcareous sandstone	4	0
(9.) Dark gray calcareous sandstone, *Murchisonia* and *Tetradium*,	1	0
(10.) Similar bed but very coarse	0	6
(11.) Hard gray limestone, *Murchisonia* and *Pleurotomaria*	1	10
(12.) Hard gray brecciated or nodular calcareous sandstone	5	0
(13.) Thin bedded, nodular dark gray limestone full of *Leperditia*	5	0

(14.) Similar limestone, *Leperditia* less numerous, also *Strophomena* and *Modiolopsis*.............................. 6 0

(15.) Hard arenaceous limestone and calcareous sandstone, with little vermicular cylinders in one bed, and fragments of *Pleurotomaria*, &c., entire.................................. 20 0

The above bed belongs to the lower part of division 3, of the previous general section, and above it there appears in the cliff a considerable thickness of similar beds capped by the beds of division 2, with some of the Trenton fossils enumerated in the list attached to that division............ 60 feet or more.

When these Silurian rocks were deposited, the older Laurentian series must have been much in its present state. It formed a broken and indented coast lower than the present shore; but its beds were as hard and crystalline, and perhaps as much contorted as they now are. The sea beat against it as now, and this for a very long time; for the deposition of the Silurian sandstones was slow, as is evidenced by the thoroughly rounded grains of sand of which many thick beds are composed, and which indicate the toil of the waves for long ages on the Laurentian shore, first, in breaking up its hard masses, then in grinding these fragments and polishing them into perfectly rounded forms. In the sandstones of some later formations, as for instance in the carboniferous system, the grains are usually angular, but in the Lower Silurian, (and in conversation with Sir Wm. Logan, I find that he has elsewhere observed this appearance,) time has been given carefully to round and polish every grain. In modern times we see such purely silicious and polished sands only on clean beaches, where few remains of plants or animals are allowed by the waves to remain, and perhaps this is connected with the absence of land remains in these old beds. I had at first suspected from the forms of these grains of quartz, that they might be concretionary like those in some green-sand deposits, but microscopic examination shows that they are not of this character, and discloses among them occasional grains of felspar and other minerals in the same rounded condition.

The Silurian beds are not themselves undisturbed. They rise sometimes with steep dips up the sides of the hills, and have been thrown into anticlinal ridges. At one place near Little Mal Bay, they run in a vertical position along the shore parallel to the older series. Here at high tide nothing is seen but the cliff of Laurentian rock, but at low tide a wide shore covered with boulders is laid bare, and stretching along this are seen the edges of the ver-

tical Silurian beds, which have been cut down to the sea level, while their sturdier Laurentian neighbours tower above them in a precipice 200 feet high, (Fig. 3.) On the sides of the bay the Silurian beds in some places reach up the sides of the hills to a

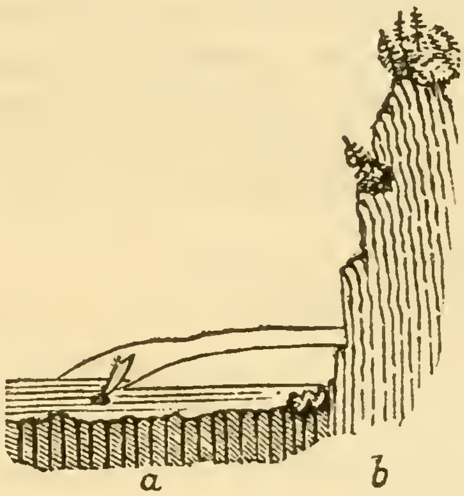


Fig. 3.
Section near Little Mal Bay.
(*a*) Lower Silurian.
(*b*) Laurentian.

height of 300 feet, and they are seen here and there in the valley of the Murray Bay River, as far as the lakes whence it flows. In some places rugged and wasted patches of them are seen clinging to the sides of the Laurentian steeps, just as they have been left by the waves of the receding sea when it last took its departure from the land, at a comparatively modern period of geological time.

From the date of the Lower Silurian to the later tertiary period, embracing by far the greater part of the earth's geological history, at Murray Bay, as in many other parts of Canada, no geological records remain. We therefore next turn to the

Post-Pliocene Deposits.

On the west side of the bay, the Silurian rocks of White Point, immediately within the pier, and which have already been so often mentioned, form a steep cliff, in the middle of which is a terraced step marking an ancient sea level. At the end nearest the pier the sea has again cut back to the old cliff, leaving merely a narrow shelf; but toward the inner side this shelf rapidly expands into the sandy flat along which the main road runs, and which is continuous with the lower plain extending all the way to the head of the bay. In this flat the upper portion of the *Pleistocene* deposit seems to consist principally of sand and gravel,

resting on stony clay. In the former, which corresponds to the Saxicava sand of Montreal, I found only a few valves of *Tellina Groenlandica*, which is still the most abundant shell on the modern beach. In the latter, corresponding to the Leda clay, which is best seen in some parts of the shore at low tide, I found a number of deep water shells of the following species, all of which except *Spirorbis spirillum* and *Aphrodite Groenlandica* have been found in these deposits at Quebec and Montreal.

Fusus tornatus.
Trophon scalariforme.
Margarita helicina.
Pecten Islandicus.
Tellina proxima.
Saxicava rugosa.
Aphrodite Groenlandica.
Balanus Hameri.
Spirorbis spirillum,
Serpula vermicularis.

These shells imply a higher beach than that of this lower flat, which is not more than 30 feet above the present sea level. Accordingly above this are several higher terraces, the heights of which on the west side of the bay I measured roughly with a pocket level. The second principal terrace, which forms a steep bank of clay some distance behind the main road, is 100 feet in height, and is of considerable breadth, and has on its front in some places an imperfect terrace at the height of 77 feet. It corresponds nearly in height with the shoulder over which the road from the pier passes. Upon it in the rear of the property of Mr. Du Berger, is a little stream which disappears under ground, probably in a fissure of the underlying limestone, and returns to the surface only on the shore of the bay. Above this is a smaller and less distinct terrace 132 feet high. Beyond this the ground rises in a steep slope, which in many places consists of calcareous beds, worn and abraded by the waves, but showing no distinct terrace ; and the highest true shore mark which I observed, is a narrow beach of rounded pebbles at the height of 326 feet. This beach appears to become a wide terrace further to the north, and also on the opposite side of the bay. It probably corresponds with the highest terrace observed by Sir W. E. Logan, at Bay St. Paul, and estimated by him at the height of 360 feet. These two

principal terraces at Murray Bay, correspond nearly with two of the principal shore levels at Montreal, as noticed in my former paper on the *Post Pliocene* deposits,* in which it will be seen that in various parts of Canada, two principal lines of old sea beaches occur at about 100 to 150 feet, and 300 to 350 feet above the sea, though there are others at different levels. To these I have now to add an observation made last summer at Upton, in the Eastern Townships, where I saw in a cleft of the limestone quarried there for copper ore, a deposit of comminuted mussel shells, and entire valves of *Tellina Groenlandica*, *Saxicava rugosa*, and *Mya arenaria*, lying just as the surf drove them into the fissures of this old reef, when the sea stood more than 300 feet above its present level. Guyot remarks in his late paper on the Appalachian mountain system,† that a depression of 140 feet would convert the whole of New England, and the eastern part of Lower Canada into an island; so that when the sea stood at the level of this highest beach at Murray Bay, the hills of New England, of the Eastern Townships, and of Gaspé, formed a long rocky island, separated from the similar masses of hills to the west and south-west, by straits 30 fathoms deep, and all the plain of the St. Lawrence was a sea with but a few rocky islets projecting from it here and there. These stupendous changes belong to the later geological history of Canada, and its re-elevation into dry land belongs to the beginning of the modern period of geology. In the valley of the Murray Bay River, there are evidences of less important but interesting processes attending this re-elevation of the land.

In the *Pleistocene* period the valley of the river has been filled, almost or quite to the level of the highest terrace, with an enormously thick mass of mud and boulders, washed from the land and deposited in the sea bed during the long periods of newer *Pliocene* and *Pleistocene* submergence. Through this mass the deep valley of the river has been cut, and the clay, deprived of support and resting on inclined surfaces, has slipped downward, forming strangely shaped shelves, and outlying masses, that have in some instances been moulded by the receding waves, or by the subsequent action of the weather, into conical mounds, so regular that it is difficult to convince many of the visitors to the bay that they are not artificial. Sir W. E.

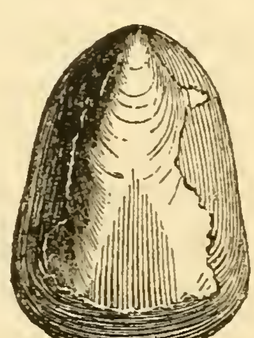
* Canadian Naturalist, Vol. II.
† Silliman's Journal.

Logan in his report above referred to, has in my view given the true explanation of these mounds, which may be seen in all stages of formation on the neighbouring hill sides. Their effect to a geological eye is to give to this beautiful valley an unfinished aspect, as if the time elapsed since its elevation had not been sufficient to allow its slopes to attain to their fully rounded contour; but this appearance is no doubt due to the enormous thickness of the deposit of *Post-pliocene* mud, to the uneven surfaces of the underlying rock, and possibly also in part to the earthquake shocks which have visited this region.

My subject in this paper has been the geological history of Murray Bay, but its modern natural history is not without attraction. Its varied surface and formations afford a copious flora. Its abundant sea weeds have been already noticed in this Journal by Mr. Kemp. The beautiful white porpoises that sport in its waters, and a variety of interesting fishes may be well studied here. The marine invertebrates are not very abundant, and the rocky nature of the bottom and rapid tidal current, render dredging difficult and dangerous, but many interesting forms characteristic of the upper ranges of the St. Lawrence estuary occur. Even the ethnologist may find something interesting in the peculiarity, of a colony of Scotsmen, isolated by the neglect of their countrymen, and changed in the course of two generations, in language, manners, and religion, into French Canadians.

Description of the new species of Lingula referred to in the foregoing paper. By E. Billings.

Lingula Eva.—(Billings.)



Description.—Shell from 1 to 1½ inch in length, greatest width near the front margin, thence gradually tapering with nearly straight sides until within one fourth of the length from the beak,

from which point the sides rapidly converge to the beak; apical angle about 90°; both valves rather convex along the middle, thence descending with a flat or gently convex slope to the sides and front margin. Surface with distinct sub-imbricating concentric ridges and fine striæ, and when partially exfoliated obscure longitudinal striæ are visible.

The width at one fourth the length from the beak is usually one fourth less than it is at one sixth the length from the front margin. The following are the measurements of a specimen of the ordinary form.

Length, 12¼ lines.

Width at 3 lines from beak, 6½ lines.

Width at 2 lines from front, 9 lines.

The largest specimen found measures nearly one inch and a half in length.

The proportions vary somewhat in different individuals. The species is about the size of *L. quadrata* but differs therefrom in being narrowed from the front upwards.

Formation and Locality.—Murray Bay; in rocks which appear to represent the Black River formation.

Collector.—This fine species was discovered by Dr. J. W. Dawson.

REVIEWS AND NOTICES OF BOOKS.

The limits of exact science as applied to History.—An inaugural lecture delivered before the University of Cambridge, by the Rev. C. Kingsley, M.A., Professor of Modern History.

Mr. Kingsley, the well known and truly distinguished author of Alton Locke, Hypatia, Westward, Ho! and other works of fictitious literature, has lately been appointed to succeed, in the chair of Modern History in the University of Cambridge, the late justly esteemed and eminent thinker and critic Sir James Stephens. That he will fill this chair with honor to himself and to the University is not doubted by those who are acquainted with the historical character and philosophical tendency of his numerous and delightful writings. He belongs to that school of men in the Church of England, now known as the "Broad Church," and his name has long been associated with liberal ideas of religion, politics and education. He has always been forward to pro-

mote as well to advocate the education of the people in the highest and best sense of that term. Along with Maurice and Ruskin he has taken an active part in conducting the studies of the Working Men's College, and now that his zeal and abilities have obtained, we believe from the imperial government, a position which, in modern times, is regarded by its fortunate possessors with just pride, we may expect from his pen works of a more mature and, it may be, of a better order of literature than any he has yet published. This inaugural lecture is a promise of what may be expected from him in the course of his historical prelections. To the phenomena of human life in all its complex relations he would apply, as a method of investigation, the principles of strict induction as opposed to the methods of theory and abstract philosophy. He plainly opposes himself to the apparent tendency of modern scientific philosophy, which aims at reducing social life and progress to the rank of phenomena which are the result of fixed and inevitable laws. Our author insists on the limitation of the idea of law, so justly applicable to the exact or physical sciences, in its application to historical questions. In the treatment of these he would introduce the higher factors of an all-pervading providence and a moral free agency in man. While he recognises in social life, as well as in physical phenomena, order and progress, he yet regards these as results not so much of fixed and inevitable laws as of a direct divine agency and the moral affections of individual men. In history he would search for effective rather than final causes, is content to see God working everywhere without impertinently demanding of him a reason for his deeds, he would have students to study in a frame of mind equally removed from superstition on the one hand and necessitarianism on the other. He fears not to confess natural agencies, but neither is he afraid to confess those supernatural causes which underlie all existence, save God's alone. This lecture is admirable as well for its lucid and profound thought as for its plain common sense.

The Life of William Scoresby, M.A., D.D., F.R.SS.L. and E., &c.—By his nephew, R. E. Scoresby Jackson, M.D., &c. London: T. Nelson & Sons. Montreal: B. Dawson & Son.

This book has been compiled from an autobiographical sketch of the early days of the subject of it, written in the Green-

land seas between the years 1821 and 1823, interspersed with brief annotations by the author. The object of the book is to place concisely before the reader the history of one who was remarkable for singular activity of mind and acute observation, who in early life enlarged the sphere of his scientific researches by repeated voyages, was the first to make an accurate survey of the east coast of Greenland, who penetrated further into the arctic seas than any of his contemporaries; a philosopher whose acute intellect embraced some of the subtlest subjects of physical science. Dr. Scoresby was the first to draw renewed national attention to arctic exploration. His volumes published in the early part of the century on the arctic regions were esteemed at the time of the highest value both in the departments of Geography and Natural History. That, however, for which the subject of this memoir is so justly celebrated is his researches and discoveries in magnetism. To the last he continued to be a zealous investigator into the phenomena of this subtle and curious force. To his labours we are indebted for most valuable improvements in the Mariner's Compass. The Admiralty Compass was the fruit of his unrequited genius, and but for an act of meanness on the part of the Admiralty board, should have been called the "Scoresby Compass." To the position and arrangement of the Compass in iron ships, he devoted the latter days of his life, and by a series of beautiful experiments demonstrated the magnetic character of such ships leaving little more to be desired for the practical purposes of navigation. After spending several years in the Greenland whale fishery, Dr. Scoresby took orders in the Church of England, and was successively Chaplain of the Mariner's Church, Liverpool, Vicar of Bradford and lecturer in Upton. His piety was deep and sincere. A zealous philanthropist, he devoted his time and attainments for the public good. His life is one of singular and pleasing interest, and its history is told with simplicity, truthfulness and affection.

Manual of Modern Geography, Mathematical, Physical and Political, on a new plan, embracing a complete development of the river systems of the globe.—By the Rev. Alex. Mackay, A.M., F.R.G.S. Wm. Blackwood & Sons, Edinburgh. B. Dawson & Sons, Montreal.

"The Manual is marked by the prominence it gives to the *physical* geography of our globe. The *second* part is wholly devoted

to this, and very ably executed. It gives a general view, with valuable tables of the chief elements, of the physical aspects and constituents of the world at large. But the physical geography of every particular country is also fully given, and in close connection with the *political*, or rather intermingled with it. But perhaps the characteristic feature in the plan is *the full development of the river system*, and the giving all the towns in connection therewith. It is but lately that this has been even partially attempted, and in no other work is it more than imperfectly, and to a limited extent, carried out. In this manual it is exhibited in singular completeness,—in the minutest details, and to the widest extent. The river basins of every country are given, the area of the basin, and the length of the principal river,—all the tributaries of this river, with their affluents, and, along with this, every city and town of any considerable size and note. The fullest attention is bestowed on all the prominent aspects and objects of the several countries. In no work that we have seen is this done in a way so interesting and elaborate. We would specially notice what is said as to the *coast lines and the lakes*. But, next to the river systems, the mountain systems are most fully developed. The great mountain ranges, with all their ramifications, are delineated with such fulness and distinctness, that one is made to feel as if from some lofty attitude he were gazing down upon them as with eagle vision.

The various sciences specially connected with geography are, in all their bearings on it, elaborately considered,—as geology, mineralogy, botany, zoology, climatology, and ethnography. Most valuable tables are given, setting before us at one view the classes, species, number, &c., of the various objects embraced in these sciences. In particular, ethnography, a most interesting science, but generally all but overlooked in such manuals, has received elaborate attention, and we are presented with all the important results of the latest researches.

Political geography, we have said, is given in its connection with the *physical*, and the two branches are thus made to throw light on each other. Statistical tables of singular value are numerous, giving, in briefest space and clearest view, the area and population of the continents, and of the several countries and kingdoms, with their capitals. To a very full and distinct delineation of the political divisions of each country, descriptive notes, many and rich in interesting information, are appended. We

have seen nothing that gives in the same brief space so clear and full a view of the eminent names in all branches of literature and science as is here given in the literary lists respecting the various countries. Statistical information of every kind is amply given.

Such is something of the plan in its leading features, and it is evidently such as to recommend the Manual strongly to our notice.

The *execution* is very able. The work is everywhere clear and comprehensive: lucid order, and terse statement, and minute detail, prevail throughout. All is very condensed but very distinct. Every topic embraced by the science is more or less fully noticed, and set in the clearest light. It is not a hasty compilation, but a work of vast labour and research. A scientific mind of high order is everywhere apparent, selecting and disposing in scientific form all the materials.

The *information* conveyed is more minute, full, and varied than we have seen in any book of the kind. We enlarge not on this, it will be manifest to any one competent to judge, who even slightly examines the Manual.

And the *most recent* information is given on every topic. We have the latest researches, discoveries, conclusions, of those most qualified to inform and guide us."—*Witness, Edinburgh.*

The cost and size of this book will prevent it from coming into general use in this country, nor does it give that prominence to Canadian Geography which is necessary for us. Many of its statements, too, concerning Canada, are incorrect and could not be taught in our schools. Excellent as this Manual is, it convincingly proves the urgent necessity of such a Canadian Geography as that now in course of publication by Mr. Lovell of Montreal.

Transactions of the Philosophical Institute of Victoria.

Wherever Britain extends her colonies, some offshoots of her noble scientific institutions springs up to bear testimony to the energy and intelligence of her sons. We have just received through the kindness of Dr. McAdam, the honorary secretary, vols. 2nd, 3rd, and vol. 4, part I of the Journal above named. The Institute has its seat in Melbourne, a city of mushroom growth, but exhibiting all the solid fruits of British civilization. Its Transactions are admirably and even sumptuously printed and illustrated, and are filled with articles on the progress of science

and the arts, and of geographical discovery in Australia. The number of short articles stating important new facts, is a very creditable feature, which we wish could be imitated here. We select for insertion one of these, principally because its subject is an interesting part of American ethnology. It is illustrated by a plate characteristically printed in gold, and which we regret that we cannot reproduce.

"The present time furnishes ample illustration of the influence gold has had in extending civilization and promoting the rapid populating of previously desert regions.

Gold, as the representative of material wealth, has always exercised a powerful influence on the actions of mankind. It is, therefore, highly interesting as well as instructive, to observe the effects produced on the natives of the wilderness by the first discovery of this metal; and it is worthy of especial note that it served a most important purpose in arousing the dormant intellectual faculties, and calling into activity the inventive genius of the untutored savage. In fact, gold and copper have, in different parts of the globe, served a most important purpose in awakening the first sparks of genius, and inducing efforts to obtain some of the benefits these metals confer on those who, by their ingenuity could turn them into articles of utility or ornament.

The history of the gradual advance in civilization of barbarous tribes shows us, among other important facts, that where no metals were found by the inhabitants, improvements in domestic conveniences were very limited; and, we also find that the discovery of metals gives the first impulse towards an early civilization. By further attention we shall likewise find that, to a certain degree, moral improvements were stimulated or retarded as the material progress of the people advanced, retrograded, or remained stationary.

Gold, we have reason to believe, was, in many parts of the world, the first metal brought into use. This was the case in South America. As soon as this valuable metal was known to be easily liquified by strong heat, it may be presumed that the desire of producing some articles of fancy as ornaments was excited. Then the first casting of some simple trinket was made. In such rude and clumsy castings we have the first proofs of this metal being applied to technical purposes, and also the first step in early civilization. It is true that the use of gold by the aboriginal inhabitants of South America was the indirect cause of much suffer-

ing to them, as their valuable massive ornaments excited the cupidity of their invaders; but the effects of the early use of this metal were of considerable value to the nation long before the disastrous invasion by the Spaniards.

Copper, also, came under notice; as, like gold, this metal is found in a native or metalic state; but, owing to the comparative scarcity of copper in some localities where gold was plentiful, the former was held in higher estimation than the latter, in consequence of certain improvements obtained by an alloy of copper and gold.

These two metals were the only ones we have any knowledge of having been discovered in that part of the continent comprising the elevated districts and table lands of the Andes, from the Atlantic Ocean to the borders of the empire of Peru, which, at the time we speak of, was in a flourishing state. To obtain the necessary heat for fusing gold, a furnace and a blast were found to be requisite; accordingly we find the very simple plan was adopted of making an excavation in the ground, and coating it with clay. In the centre some stones were placed as a fire-place; charcoal was then ignited, and the smelting pot, with the gold, placed. The heat of the burning charcoal was then increased to the required degree by a certain number of men supplying air by alternatety blowing through long canes, protected at the ends with clay, so as to produce a constant blast in imitation of a double bellows.

The original inventors made the patterns and the moulds for their castings in the following primitive but effective manner. The beeswax having been used to make toys, in the form of reptiles and other animals, for the amusement of children, these insignificant playthings were afterwards used to reproduce, in gold, what they had imitated in wax. The fancy article of wax was, therefore used as a pattern; it was imbedded in clay, a small orifice in the mould being left, made also with wax, through which the melted metal could be introduced. These moulds were then carefully dried in the sun, and afterwards gradually heated so as to melt the wax, and leave the clay-casing or mould ready to receive the fluid metal. This simple and ingenious contrivance of the original inhabitants of South America was also used to procure more elaborate imitations of the flora and fauna of Mexico and Peru.

The Spanish conquerors reached the interior of South America

in the year 1545, the northern portion of which they called "Capatania de la Nueva Granada." This included the coast land between the Gulf of Darien and the Cape de la Hacha, reaching the first degree north latitude. The interior part of this Spanish colony occupied a considerable extent of the region of the Andes, the inhabitants of which were represented as a "timid and quiet people." The gold trinkets we have alluded to were here, as elsewhere, used for ornaments by the chief or cacique, as well as the community in general, though a distinct class of ornaments seems to have been reserved for the chiefs. The principal object of the new visitors was gold, which was eagerly sought for in any form, Glass beads, and articles made of iron or steel, which were great novelties to the Indians, were readily bartered in exchange for their gold ornaments. There were, however, some ornaments they were very unwilling to part with; such as images of the chief and his wife in a sitting posture, made of gold, about ten inches high, and 16 ounces weight, and some other imitations of various animals, which were used as ornaments in the dwellings of the chiefs, and were regarded as superior articles of art. These were the cause of the first attack on the property of the inhabitants. In revenge for the outrages they suffered from their oppressors, when gold ornaments became scarce, they refused to show where they obtained this metal in its natural state.

The ornaments obtained by the first visitors being regarded merely as articles of commerce, they were mostly melted into ingots, so that very few of those specimens of early art remained; but as they were in the habit of burying some of their ornaments in the tombs of the caciques, and as some of these burial-places are occasionally discovered, samples of these ancient ornaments have been secured, which furnish interesting illustrations of the first attempt in this branch of industry. We shall, therefore proceed to describe

THE INDIAN TOMBS.

Burials were performed by the Peruvians in two different ways, above and below ground. The still existing elevated mounds remind us of the Egyptian catacombs, though those of the Peruvians are smaller, and constructed of stone and earth. These monuments of the Incas are of a pyramidal form and different dimensions, some being more than one hundred and fifty feet high, and are known by the name "Cucara." They are built in subdivisions formed of large slabs of slate. In one of these divisions

the body was placed, and in another the utensils and ornaments. Sometimes gold in its natural state was left in an earthenware vessel, mixed with pounded charcoal. When the chief or governor was interred, an imitation of the sun or the moon was placed in the tomb. The sun was represented by a flat, round plate of gold, or alloy of copper, about an eighth of an inch thick, and sometimes more than twenty inches in diameter. The moon was made of a silver plate, showing the half moon. A neck ring and bracelets, a waist band and ankle rings, made of gold, sometimes alloyed with copper, were also left with the body of a chief These rings are from one and a quarter to two inches in width, and opened and closed as a spring, They are thin and perfectly equal in width and thickness throughout. In fact, they are so perfect that it is difficult to imagine how such laminated rings were produced, considering the deficiency of suitable implements for such delicate and exact work. There are several of these tombs above ground still to be seen.

The excavated tombs,as found in our times, are all alike throughout South America. The Spanish conquerors having entered the territory of "la Capitana de la Neuva Granada," and collected all the gold they could among the Indians, turned their attention to the natural sources of gold, and also to the burial places, which soon became objects of much interest to the gold seekers. These tombs are always found on some isolated range with sharp outlines, so situated as not to admit of any water accumulating, and no apparent probability of water being led to it. In hills so situated the excavations are discovered by observing certain concavities on the surface ; but where a thick forest exists, with a dense undergrowth, often of several feet, it is necessary to clear the ground by fire. It is generally allowed that a long period has elapsed since these tombs were closed, as by the accounts of the Mexicans and Peruvians, given at the time of the conquest, their calculations amounted to about two thousand years. The excavation is circular and perpendicular, and three or four feet in diameter, dug out of the decomposed syenitic rock. At the depth of nine to eleven feet charcoal is found among the soil, under which a flat stone (some kind of slate) covers the pit, on removing which the edge of a perpendicular slab is observed. At about four feet deeper the bottom of the tomb is reached, and on the perpendicular slab being removed, a horizontal excavation is seen towards the east. This is about four feet in height and the same in width but somewhat more in length. Here the bones of the defunct are

found, the body having been placed in a sitting posture, with the face towards the east, that is towards the rising sun, regarded as the "King of the Heavens." The bones are generally found in such a decayed state that they will not admit of being handled. The earth, which has more or less fallen in and mingled with the remains, is gathered and brought under the washing process, and the trinkets thus obtained are partly of gold, with its natural alloy (silver), and partly gold with copper. On one side of the remains a large earthenware vessel is found, covered with a piece of slate, and in some instances a sediment has been found deposited from the drink, the Indian "chicha," left with the deceased. On the opposite side, perfectly decayed, ears of Indian corn have been found. In a niche cut out of the end of a tomb, a vase of earthenware is sometimes found, covered with a stone, and filled with pounded charcoal, in which the remaining trinkets and gold-dust, left with the occupant of the grave, had been deposited. Implements for smelting gold, and some tools made of gold and copper, are sometimes, though but rarely, found in the pot occupying the niche. The Spaniards, who during three centuries have gathered gold from the fluvial deposits, have found many of these burial places very remunerative.

Some localities show that systematically arranged cemeteries have formerly existed where two excavations in the centre, of greater depth than the surrounding ones, were found. The deep graves appear to have been appropriated to the chiefs and their families, and the numerous others to the inferior classes. These burying places are termed "Pueblo de Indios," but these larger cemeteries are now seldom found. Traditional accounts of certain localities are still preserved and eagerly sought after, where great treasures are said to have been buried. In like manner reports are often heard of rich fluvial deposits of a more recent date, where the proprietor is said to have had a measure corresponding to about twenty to twenty-five pounds weight, on collecting his weekly produce. This may be regarded as probable, if we consider that as many as from two to three hundred African slaves were often employed in mining pursuits by one proprietor.

The foregoing narrative supplies a proof that the aboriginal inhabitants of South America had some indefinite notion of a future state; they appear to have believed "that their deceased relative or friend had a long way before him," and that he would require some refreshment in his long journey to "reach the stars." This idea still extensively prevails."

THE

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ARTICLE X.—*On the Pre-carboniferous Flora of New Brunswick, Maine, and Eastern Canada.* By J. W. DAWSON, LL.D., F.G.S., &c.

(Read before the Natural History Society.)

The known flora of the rocks older than the Carboniferous system, has until recently been very scanty, and is still not very extensive. In Goeppert's recent memoir on the flora of the Silurian, Devonian, and Lower Carboniferous rocks,* he enumerates 20 species as Silurian, but these are all admitted to be Algæ, and several of them are remains claimed by the zoologists as zoophytes, or trails of worms and mollusks. In the Lower Devonian he knows but 6 species, five of which are Algæ, and the remaining one a *Sigillaria.* In the middle Devonian he gives but one species, a land plant of the genus *Sagenaria.* In the upper Devonian the number rises to 57, of which all but 7 are terrestrial plants, representing a large number of the genera occurring in the succeeding Carboniferous system.

Goeppert does not include in his enumeration the plants from the Devonian of Gaspé, described by the author in 1859,† having seen only an abstract of the paper at the time of writing

* Jena, 1860.

† Journal of Geological Society of London, also Canadian Naturalist.

his memoir, nor does he appear to have any knowledge of the plants of this age described by Lesquereux in Rogers' Pennsylvania. These might have added ten or twelve species to his list, some of them probably from the Lower Devonian. It is further to be observed, that certain specimens found in the Upper Ludlow of England,* appear to prove the presence of *Lepidodendron* in that formation; and that in the paper above referred to, I have noticed specimens from the Gaspé limestone which seem to me to indicate the occurrence of *Psilophyton* and *Noeggerathia* or *Cordaites* in the Upper Silurian of Canada.

It thus appears that, according to our present knowledge, the plant life of the land, so rich in the coal formation, dies away rapidly in the Devonian, and only a few fragments attest its existence in the Upper Silurian. Great interest thus attaches to these oldest remains of land plants; and fragmentary though they are and often obscure, they merit careful attention on the part of the geologist and botanist.

No locality hitherto explored, appears more favourable to the study of this ancient vegetation, than those parts of Eastern America to which this paper relates. The Gaspé sandstones have already afforded six Devonian species, some of them of great interest, and in a remarkably perfect state of preservation; and from beds of similar age in New Brunswick and Maine, I am now prepared to describe at least ten species, most of them new. This already raises the species found in the band of Devonian rocks, extending through the north-eastern States of the Union, and the eastern part of British America, to one-third of the number found in all other parts of the world; and the character of the containing rocks, the number of nondescript fragments, and the small amount of exploration hitherto made, justify the hope that a much larger number may yet be discovered.

Of the plants described in this paper, only a few have been discovered by myself. The greater part are from the following sources. (1) The collection of Mr. G. F. Matthew, of St. John, New Brunswick; (2) a collection from Perry, Maine, made by Mr. Richardson for the Geological Survey of Canada; (3) specimens from Perry in the collection of the Natural History Society of Portland. Several of these plants have been long known. Some of those found at St. John are noticed by Dr. Gesner in his re-

* Murchison's Siluria, p. 152, Journal Geol. Socy. Vol IV.

port on the geology of New Brunswick; and specimens were shown to me several years ago, by the late Professor Robb of Fredericton. Those from Perry are mentioned in the report of Dr. Jackson on the geology of Maine, and have also been noticed by Prof. Rogers in the proceedings of the Natural History Society of Boston. No adequate description of them has however yet been published; and it is to this task that I would address myself in the present paper. I shall notice first the plants from St. John, next those from Perry, and finally a new form from Gaspé.

1. St. John, New Brunswick.

The city of St. John stands on the rocks constituting what I have elsewhere termed the coast metamorphic belt of New Brunswick,* an irregular ridge rising through the Carboniferous rocks, and extending from Shepody mountain south-westward along the north side of the Bay of Fundy to the St. John River, westward of which it expands into a broad band of metamorphic and plutonic rocks, extending into the State of Maine. In the vicinity of St. John these rocks consist principally of white and gray crystalline limestone, hard shales and slates of various colours and qualities, quartz rock, and indurated gray sandstone. With these are associated syenite, greenstone, and trappean rocks, some of the latter appearing to be interstratified. The crystalline limestone is of great thickness and destitute of fossils; but contains small quantities of graphite. In the shales near the limestone is a regular bed of graphite, attaining in places a thickness of four feet. It is of coarse quality, and retains obscure traces of vegetable structure. Some of the beds of sandstone and shale contain numerous fossil plants, their carbon being in the state of graphite, and the fragments, though abundant, not easily studied, owing to their imperfect preservation, and the hardness of the enclosing rock. A bed of sandy shale is filled with fragments of *Lingula*, which were discovered by Prof. Rogers, but which neither he nor Mr. Billings, to whom I have shown specimens, can refer to any known species.

The arrangement of the beds at St. John is shown by the ac-

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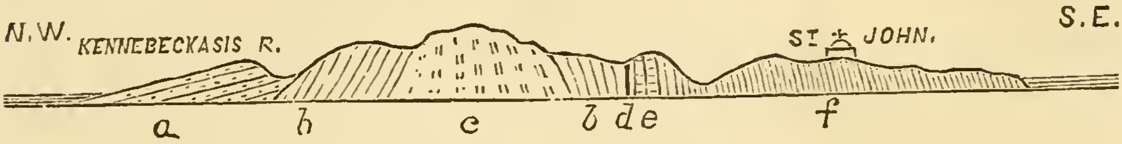
* Acadian Geology.

companying section prepared by Mr. Matthew, and which accords with such observations as I have been able to make.



Section of the vicinity of St. John.

(*a*) Lower carboniferous conglomerate. (*b*) Crystalline limestones of St. John group. (*c*) Syenite. (*d*) Bed of graphite. (*e*) Interstratified trappean rock. *(f)* Slates, shales, and sandstones of St. John group.

With respect to the age of these beds; in the absence of determinable animal fossils, I may state the following facts. (1) The limestone and its associated shales underlie unconformably the Lower Carboniferous conglomerate, which here appears to be the oldest member of that system. This arrangement is general throughout the belt to which the St. John rocks belong. (2) The whole of the beds of the St. John group, appear to be conformable to one another and to constitute one formation. (3) In mineral character, and especially in the occurrence of thick beds of limestone and of graphite, the St. John rocks do not resemble any of the Devonian or Silurian rocks of Nova Scotia, though these occur in a similar state of metamorphism. They more nearly resemble the Devonian of Gaspé. The Devonian rocks known in Nova Scotia, appear to belong to the lower rather than to the upper member of that system,* and they have afforded no plants except indeterminable fragments. (4) The plants found in the rocks of the St. John group, are specifically distinct from those of the Carboniferous system in Nova Scotia and New Brunswick.

In the map attached to Prof. Johnston's Report on the Agriculture of New Brunswick, Prof. Robb has coloured these rocks as Lower Silurian. In my Acadian Geology, on the ground chiefly of mineral character, I have with doubt placed them as Upper Silurian or Devonian. The facts at present known show them to be older than the Carboniferous system, though perhaps belonging to the newest part of the Devonian.

The following are the plants which I have been able to determine :—

* Supplement to Acadian Geology, also Canadian Naturalist, Vol. 4.

1. *Dadoxylon Ouangondianum.**—Sp. nov.

Fig. 1.

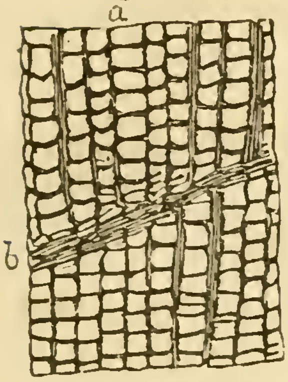
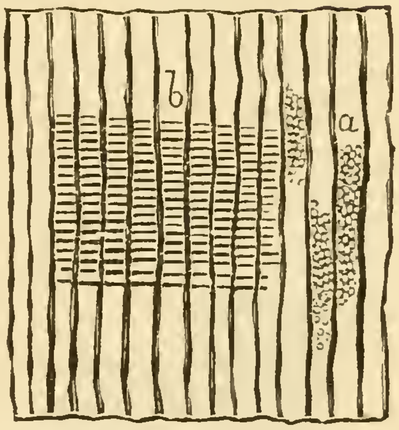


Fig. 2.



Figs. 1and 2.—*Dadoxylon Ouangondianum.*

Fig. 1.—Transverse section 50 diams. (*a*) Wood cells. (*b*) Line of growth.

Fig. 2.—Longitudinal section, radial. (*a*) Disc structure. (*b*) Medullary rays.

Description.—Branching trunks, with distinct zones of growth, and a pith of Sternbergia type. Wood cells very large, with three to five rows of contiguous alternate hexagonal areoles with oval pores. Medullary rays with one to three series of cells, and as many as 14 rows of cells superimposed on each other.

Trunks of this fine coniferous tree are not infrequent in the St. John sandstones explored by Mr. Matthew. They retain their structure in great perfection, especially in silicified specimens. Some of the trunks have been a foot or more in diameter. They show traces of growth rings on their weathered ends, and when perfect, are traversed by the transversely wrinkled pith cylinders, formerly known as *Sternbergiæ.* Under the microscope the wood cells are seen to be of remarkable size, being fully one-third larger in their diameter than those of *Pinus strobus* or *Araucaria Cunninghami*, and also much larger than those of the ordinary coniferous trees of the coal measures. They are beautifully marked with contiguous hexagonal areoles, in which are inscribed oval slits or pores, placed diagonally. The medullary rays are large and frequent, but their cells, unlike the wood cells (prosenchyma), are more small and delicate than those of the trees just mentioned. The pith when perfectly preserved, presents a

* I have named this species after the ancient Indian designation of the St. John River, *Ouangonda.* I use the generic term Dadoxylon as probably best known to English geologists; but I sympathise with Goeppert in his preference of the generic term *Araucarites* for such trees.

continuous cylinder of cellular tissue, wrinkled longitudinally without, and transversely within, and giving forth internally delicate transverse partitions which coalesce toward the centre,

Fig. 3.

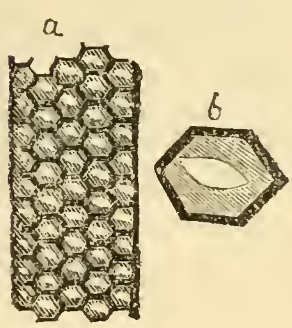
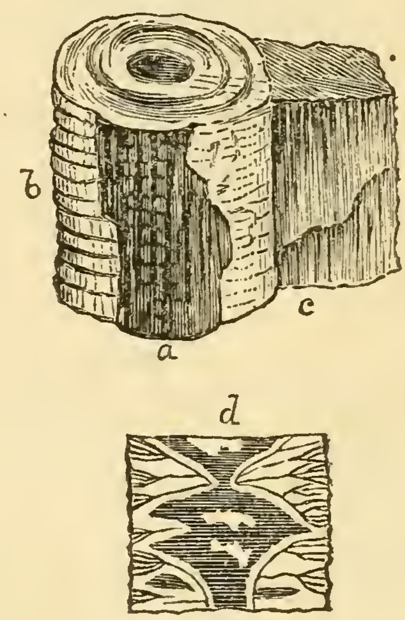


Fig. 4.



Figs. 3 and 4.—*Dadoxylon Ouangondianum.*

Fig. 3.—Fragment of wood cell prepared by nitric acid. (*a*) 200 diameters. (*b*) Single areole more highly magnified.

Fig. 4.—Sternbergia pith. (*a*) Outer carbonised coating. (*b*) Transverse plates. (*c*) Fragment of wood attached to exterior. (*d*) Section showing internal structure, natural size.

leaving there a series of lenticular spaces, a peculiarity which I have not heretofore observed in these Sternbergia pith cylinders. It is interesting to find in a Devonian conifer the same structure of pith characteristic of some of its allies in the coal formation, where however, as I have elsewhere shown,* such structures occur in Sigillaria as well; and since Corda has ascertained a similar structure in *Lomatofloyos,* a plant allied to Ulodendron, it would appear that the Sternbergiæ may have belonged to plants of very dissimilar organization.

In my specimen the pith is only half an inch in diameter, and only a small portion of the wood is attached to it; but Mr. Matthew has a specimen of a trunk ten inches in diameter, with the pith one inch in thickness, and another $11\frac{1}{2}$ inches in diameter, with the pith $2\frac{1}{2}$ inches. Both had the appearance of decayed trunks, so that their original size may have been considerably greater.

* Paper on Coal Structures. Journal of Geol. Survey.

Mr. Matthew states in reference to the mode of occurrence of this interesting species, that the wood is always in the state of anthracite or graphite, or mineralized by iron pyrites, calc spar or silica. The pith is usually calcified, but in pyritised trunks it often appears as a sandstone cast with the external wrinkles of Sternbergia. The pith is often eccentric, and specimens occur with two or three centres; but these either consist of several trunks in juxtaposition, or are branching stems. The annual layers vary from $\frac{1}{8}$th to $\frac{1}{30}$th of an inch in thickness, and adjoining layers sometimes vary from $\frac{1}{10}$th to $\frac{1}{20}$th of an inch.

The trunks of this species appear to have had a strong tendency to split in decay along the medullary rays, and in consequence the cross section often presents a radiating structure of

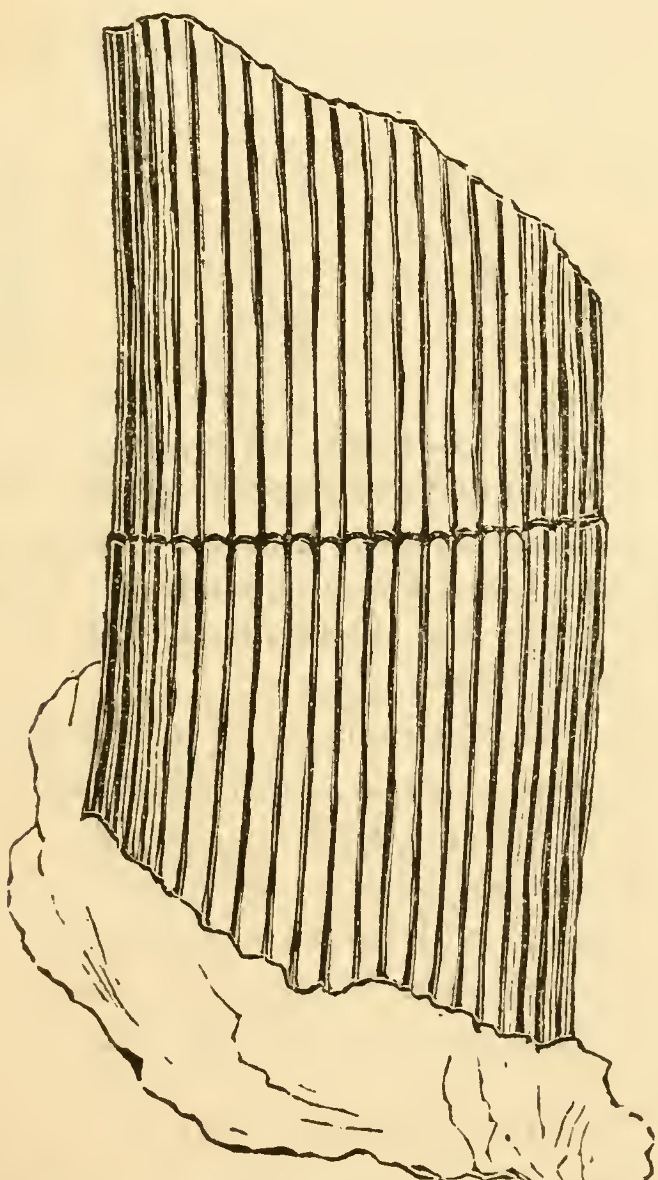


Fig. 5.—*Calamites transitionis.* (p. 168.)

alternating black lines representing the wedges of wood, and white rays of calc spar. The heart wood seems to have had its cell

walls much thickened, and in consequence to have been more durable than that nearer the surface. They appear to have been drift trees, and to have been much worn and abraded before they were imbedded in sediment.

2. *Calamites transitionis.*—Goeppert.

(Fig. 5—*previous page.*)

The specimen figured appears to belong to the species above named, which occurs in the Devonian of Silesia, and also in the Lower Coal Formation. It is a cast in sandstone, showing merely the decorticated surface in an indifferent state of preservation. Specimens of this species were shown to me in 1857, by the late Prof. Robb, and were the first well characterized plants from the St. John rocks, that had come under my notice.

3. *Asterophyllites parvula.*—S. n.

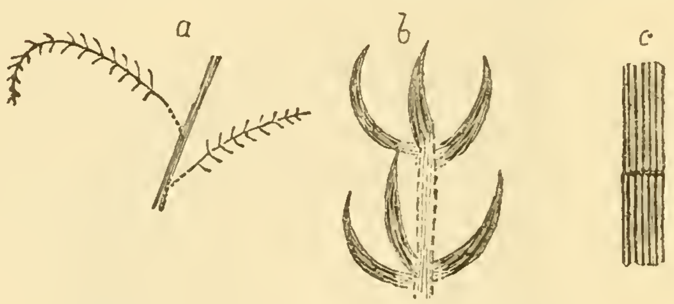


Fig. 6.—*Asterophyllites parvula.*

(*a*) Natural size. (*b*) Portion magnified. (*c*) Stem natural size.

Description.—Branchlets slender. Leaves 5 or 6 in a whorl, subulate, curving upward, half a line to a line long. Internodes equal to length of leaves or less. Stems ribbed, with scars of verticillate branchlets at the nodes.

This delicate little species is found abundantly in graphitic shale, on the surfaces of which its branchlets and leaves appear as shining films of graphite, as if delicately drawn with a black lead pencil. It can be extracted from the shale only in fragments; but associated with these are remains of stems about a line in thickness, with about 16 ribs and prominent nodes with little tubercles indicating the attachment of branchlets.

4. *Cordaites* (*Pycnophyllum*) *Robbii.*—S. n.

Description.—Leaves elongated, parallel-sided, an inch or more in width, with very delicate equal longitudinal striæ.

This is the characteristic plant of the graphitic shale above mentioned, to which its leaves, converted into graphite, aid in

giving a thin lamination. For this reason I desire to dedicate it to my late lamented friend, Prof. Robb, who has been called away in the midst of labours that would have added much to our knowledge of the geology of New Brunswick. I have seen no specimens of this leaf entire; but it appears to have been a broad lanceolate or oblong leaf, resembling the common Cordaites of the coal measures, but more delicate in its striation. Mr. Matthews has found specimens 3 inches in width.

The generic name *Cordaites* as used here, may require some explanation. I employ it as applied by Unger to the *Flabellaria borassifolia* of Corda, which I regard as the type of all those broad parallel-veined elongated leaves, which have by various authors been placed in the genera *Pycnophyllum*, *Noeggerathia*, *Poacites*, and *Flabellaria*. The first of these names. proposed by Brongniart, I regard as a synonym of Cordaites; but I have no certain information as to its priority to that name. The second, *Noeggerathia*, was originally applied to flabellate and pinnate leaves, quite distinct from that now described.* It has by some authors been restricted to a genus of ferns allied to Cyclopteris and by others still included in that genus;† and latterly it is used by Goeppert,‡ and by Unger,§ to include parallel veined leaves, like the present species, but placed among monocotyledonous plants, and said to be pinnate, though there is no evidence of this in several of the species, some of which may possibly belong to Cordaites, and others, as *N. tenuistriata*, (Goeppert,) are probably stipes of ferns allied to my *Cyclopteris Acadica*. *Poacites*, if *P. cocoina* (L. and H.) is considered its type, cannot include these leaves, and *Flabellaria* is now restricted to leaves of palms, quite dissimilar from Cordaites.

By the use of the generic name which I have selected for the above reasons, I hope to avoid all the confusion in which the nomenclature of leaves of this type has long been involved. I do

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* Lindley and Hutton, Fossil Flora. It is to these leaves, represented by *N. foliosa* and *N. flabellata*, that the name properly belongs, and it appears desirable that they should be more distinctly separated on the one hand from ferns of the genus Cyclopteris, and on the other from plants like that now under consideration.

† Lesquereux in Rogers' Pennsylvania. See also Unger, Genera et Species, and Goeppert, Gattnung.

‡ Flora des Uebergangsgebirges, and Flora der Silurischen, &c.

§ Unger Palæontologie des Thuringer waldes.

not express any opinion as to their affinities, any farther than to state my belief that they present no important point of structural difference from *Cordaites borassifolia*, and that this plant as described by Corda,* has a stem closely resembling Lomatofloyos, and therefore of the same type of structure with Ulodendron and Lepidodendron.

5. *Cordaites angustifolia.*—S. n.

Description.—Leaves elongated, one-tenth to one-fourth of an inch wide, with delicate equal parallel striæ.

This leaf differs from the last in its proportionate narrowness and decided striation. No specimen showing its extremities has been obtained, in consequence of which, I cannot determine whether it has the retuse apex mentioned as one of the characters of Unger's *Noeggerathia graminifolia*, which in form and dimensions it much resembles. A very similar leaf, probably the same species, occurs in the Devonian and Upper Silurian of Gaspé, and is represented in Fig. 11. It was noticed in my paper on the plants of that region, as probably a Noeggerathia.

6. *Sphenophyllum antiquum.*—S. n.

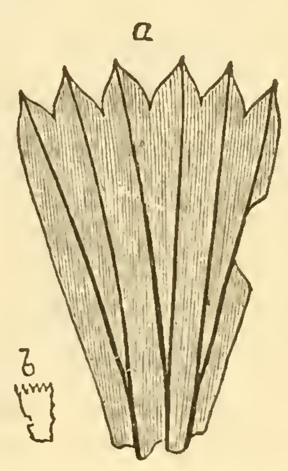

Fig. 7.—*Sphenophyllum antiquum.*
(*a*) Magnified. (*b*) Natural size.

Description.—Leaflets cuneate, one-eighth of an inch wide at apex, and less than one-fourth of an inch long. Nerves three, bifurcating equally near the base, the divisions terminating at the apices of six obtuse acuminate teeth.

This is the first occurrence, in so far as I am aware, of the genus Sphenophyllum in beds older than the carboniferous system. Leaflets only were found, so that it is impossible to state the arrangement of these on the stem; but the form and nerva-

* Flora der Vorwelt; under genus *Flabellaria.*

tion of the leaflets are well defined. Under the microscope the nervures have a striated appearance, and there is a more delicate longitudinal striation visible in the epidermis of the leaf. I may remark here, that though in a somewhat altered rock, and to a cursory glance indistinct, the leaves and other delicate vegetable organs in the shales of St. John, are found under the microscope to present an unusual degree of perfection in their finer markings. They must in the first instance have been imbedded in a quite unchanged condition, and but for the alteration which the rocks have sustained, would have furnished remarkably perfect specimens. The species above described approaches most nearly to *S. erosum* of the coal measures, but differs in its proportions.

7. *Lycopodites Matthewi.*—S. n.

Fig. 8.—*Lycopodites Matthewi.*

(*a*) and (*b*) Natural size. (*c*) Magnified. (*d*) *Lepidophyllum.*

Description.—Leaflets one veined, narrowly ovate-acuminate, one-tenth to one-fourth of an inch in length, somewhat loosely placed on a very slender stem, apparently in a pentastichous manner.

This pretty little species is abundantly displayed in graphite, in the Cordaites shale I have already referred to. With it are found the little scales or Lepidophylla, (Fig. 8, d.) which may possibly have belonged to its fructification.

In addition to the above plants, there is in the sandstone containing conifers, an impression of the bark of a plant which may have been a *Sigillaria.* In the Cordaites shale there are many indeterminable fragments, among which are a small fern leaf, apparently a *Sphenopteris* like *S. Devonica*, Unger, a terminal pinnule of a *Cyclopteris*, which appears to be the same with that described below from Perry, leaves having the appearance of those of *Sigillaria*, (Cyperites), and stems which may belong to *Psilophyton.* There are also some remarkable fragments which

in some aspects appear to be transversely furrowed stems with longitudinal striæ, and in other specimens present the appearance of monocotyledonous leaves, with strong longitudinal nerves and more slender transverse ones. These are perhaps stipes of ferns, some species of Cyclopteris presenting a somewhat similar appearance in their flattened petioles. There also occur both at St. John and Gaspé, carbonaceous films of uncertain form, and minutely pitted all over, the precise nature of which I cannot determine.

II. Perry, Maine.

The rocks at this place consist of sandstones and shales, very closely resembling those of Gaspé. They were first described by Dr. Jackson, in his Report on the Geology of Maine. More recently they have been noticed by Prof. Rogers, in the Proceedings of the Natural History Society of Boston. Prof. Rogers regards them as of Devonian date, in which view Dr. Jackson concurs, and the evidence of the plants is favourable to the same conclusion. Their stratigraphical relations have not, however, been accurately worked out. Mr. Richardson, of the Geological Survey of Canada, represents them as apparently resting unconformably on metamorphic rocks of uncertain date, but which, according to some recent observations of Prof. Rogers, may be in part of Upper Silurian age. The fossils from this place which have come into my hands, are preserved somewhat imperfectly in hard coarse sandstone. They consist of the following species:—

1. *Cyclopteris Jacksoni.*—S. n.

I think it but just to name this fine species after its original discoverer, and the explorer of the geology of Maine. It is closely allied to *C. Hibernica* and *C. McCoyana* from the Devonian of Ireland; but is sufficiently distinct to constitute a well marked species. It resembles the ferns just named in the dense arrangement of its pinnules, which largely overlap each other; but it differs from them in the arrangement of the pinnæ, in the form of the pinnules, and in the character of the rhachis. It seems quite distinct from any of the ferns from the Devonian of Pennsylvania, &c., described by Lesquereux. The specimen figured is one in the collection of the Natural History Society of Portland.

In Mr. Richardson's collection, single pinnæ occur, and there are also many large stipes which may have belonged to this species.

Fig. 9.—*Cyclopteris Jacksoni.*

(*a*) Terminal pinnule. (*b*) Lateral pinnules slightly magnified.

Description.—Frond bipinnate; rhachis stout and longitudinally furrowed; pinnæ alternate; pinnules obliquely obovate, imbricate, narrowed at the base, and apparently decurrent on the petiole; nerves nearly parallel, dichotomous; terminal leaflet large, broadly obovate or lobed.

As above stated, terminal pinnules which may have belonged to this species occur in the St. John beds; but more

perfect specimens will be required to render this identification certain.

2. *Lepidostrobus Richardsoni.*—S. n.

(Fig. 10.)

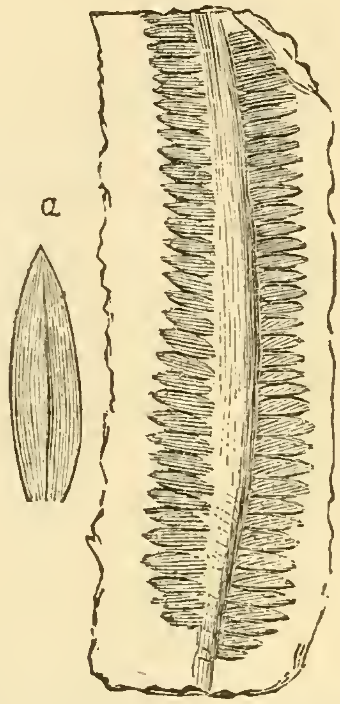

Fig. 10—*Lepidostrobus Richardsoni.*

(*a*) Pinnule magnified.

Description.—Axis not distinctly preserved, form cylindrical?—scales oblong with an obscure midrib.

I refer to the above genus with some hesitation, a well characterised but very puzzling organism, discovered by Mr. Richardson at Perry. It consists of an indistinct but apparently thick stem or axis, with equally pinnate leaves, which seem to have been thick and oblong and show traces of a midrib. It resembles a perfectly flattened Lepidostrobus, more than anything else; but it may have been a branch of a conifer with pinnate leaves.

3. *Lepidostrobus,* ———— S. n.

In Mr. Richardson's collection from Perry, is a rounded and flattened object, $1\frac{1}{2}$ inch in diameter, apparently covered with thick pointed scales. It seems to be a Lepidostrobus quite distinct from the last.

4. *Lepidodendron Gaspianum.*—mihi.

In a specimen in the collection of the Natural History Society of Portland, there is a branch of Lepidodendron, $7\frac{1}{2}$ inches in length, $\frac{1}{2}$ inch in diameter at the larger end, and $\frac{1}{3}$ inch in dia-

meter at the smaller. It is flattened and imperfectly preserved, but on comparison with my specimens from Gaspé, I cannot observe any specific difference. This species is evidently closely allied to *L. nothum*, Unger, and possibly could perfect specimens of both be obtained, they might prove to be identical. In the mean time however as the scars and leaves of *L. nothum* are unknown, it is difficult to institute a comparison.

5. *Psilophyton princeps.*—mihi.

Great numbers of slender bifurcating stems appear on the shales brought from Perry by Mr. Richardson. They are not well preserved; but it seems scarcely to admit of a doubt that they belong to this species, so characteristic of the Gaspé sandstones.

6. *Megaphyton?*

A flattened stem two inches in diameter, irregularly ribbed and striated, appears to show a row of scars on the exposed side, as in the above named genus. The scars are not however well defined. The plant has a slender pyritised axis giving off a few bunches or bundles of vessels to the sides. The structure is very imperfect but was possibly scalariform.

7. *Sternbergia.*

In the collection with which I have been favored by the Natural History Society of Portland, is an impression of a Sternbergia not distinguishable from that of *Dadoxylon Ouangondianum*, of St. John, to which species it perhaps belonged. It retains no traces of the wood; but casts of sternbergia in the same naked condition often occur in the coal measures.

8. *Aporoxylon.*

Many fragments of carbonised wood showing aporous cells occur in the Perry sandstones: I refer them in the mean time to the above genus of Unger.

III. Gaspé Sandstones.

From these rocks I have but one species to notice at present. It is that referred to in my former paper as probably a Knorria,*

* Paper on Devonian Plants of Gaspé, Journal of Geological Society, Vol. XV.

but of which I have recently obtained better specimens which induce me to propose for it the name of—

Selaginites formosus.—S. n.

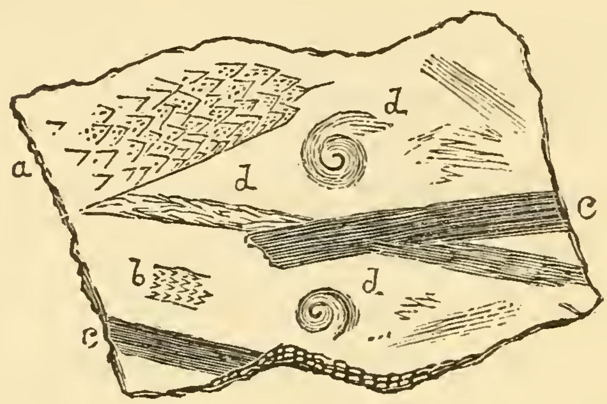

Fig. 11.—Fragment of shale from Gaspé.

(*a*) *Selaginites formosus.* (*b*) Smaller specimen of the same. (*c*) *Cordaites angustifolia.* (*d*) *Psilophyton princeps.*

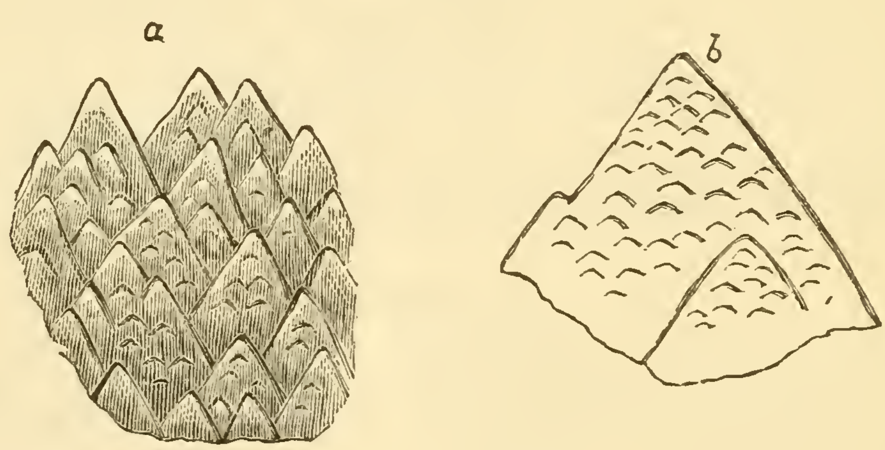

Fig. 12.—*Selaginites formosus.*

(*a*) Small specimen magnified. (*b*) Scale of larger specimen magnified.

Description.—Stems covered with flat broad angular imbricating scales of unequal size, and ornamented with minute scaly points.

The original specimen of this curious plant was a fragment of the bark on sandstone in the collection of Sir W. E. Logan. I have since discovered in the bituminous shale overlying the Devonian coal of Gaspé, and which abounds in vegetable fragments, several portions of flattened stems showing the characters more perfectly. The different sizes of the fragments and of the scales that clothe them would indicate that it was a branching or dichotomous plant. Their condition of preservation shows that

the bark was firm and durable. The scales are flat, quite angular and closely appressed, but seem to have been thick, and are evidently free at their extremities and without any indication that they supported leaves. They show no ribs or nervures; but are covered with little subordinate projecting points or scales as shown in the figures.

I formerly referred this plant to Knorria, on account of its scaly stem; but this genus has recently been placed in a somewhat equivocal position by Goeppert,* who finding, as I had previously done,† that the plants called Knorria in the Lower coal measures, are really decorticated or imperfectly preserved Lepidodendra or Sagenariæ, seems disposed to abandon the genus.

The present species might however still remain as a typical Knorria having a scaly stem and quite distinct from Lepidodendron, but to avoid any confusion between it and the plants heretofore known as Knorria but now ascertained to be of a different character, I prefer to place it in the mean time in Selaginites; in the hope that more perfect specimens may soon illustrate more fully its affinities.

Concluding Remarks

In comparing with each other the plants of the three localities above referred to, it will be observed that they have few species in common. Probably two species are common to Perry and St. John, and two to the former and Gaspé; while it is doubtful if one is found in all three. It must be observed however that according to Mr. Billings, the fossil shells of the Gaspé sandstones indicate a Lower Devonian age, while it is quite probable that the rocks of Perry and St. John may be Upper Devonian; and this is the more likely as the plants of the St. John beds are decidedly nearer in their facies to those of the coal formation than are those of Gaspé.

None of the species found in these old beds have as yet been recognised in the carboniferous system in British America; and only one, *C. transitionis*, elsewhere. The generic types are however the same, with the exception of *Prototaxites* and *Psilophyton*,

* Flora der Silurischen, &c., 1860.

† Paper on Lower Coal measures, Journal of Geological Society, Vol. XV. P. 69.

and possibly also the form of Cyclopteris represented by *C. Jacksoni*, which differs from any fern of the coal formation, and is perhaps entitled as Lesquereux maintains to a distinct generic name. The generic assemblage in the beds now under consideration, resembles that in the lower coal formation, and differs from that in the true coal measures, in the prevalence of Lycopodiaceus plants and the comparative absence of Sigillariæ; but the genera Lepidodendron and Sagenaria so characteristic of the lower coal measures are slenderly represented here. It is also to be observed that the genera Asterophyllites and Sphenophyllum, though common to the St. John group and the coal measures, are, in so far as known, absent from the lower coal formation in Nova Scotia and New Brunswick. The former genus is however found in the Lower coal in Silesia. It is interesting to observe in the St. John beds which have been disturbed and metamorphosed before the carboniferous period, a generic assemblage so similar to that of the coal. On the other hand it is still more curious to find that the absence of the great Sigillaroid and Ulodendroid trees, so characteristic of the wide swampy flats of the coal period, gives to the St. John flora a more modern aspect than that of the coal; though in its exclusively cryptogamous and gymnospermous character, and in its generic forms, it is quite as decidedly palæozoic.

In comparing the plants in the Devonian of Eastern America with those of Europe, a smaller proportion of identical species appears than in the case of the coal measures. There may have been in the Devonian period a greater geographical separation or climatic difference between the European and American land than in the time of the coal formation. On the other hand, however, a part of the plants ascertained here belong to the Lower Devonian, which has hitherto afforded only one land species in Europe, while here it contains several well preserved species and even a small bed of coal; and with respect to the Upper Devonian the number of known species is too small as yet to admit of a satisfactory comparison.

I trust that the species described in this and my previous paper are but a small instalment of those to be brought to light by further search. In the meantime I present the following summary of these species, as representing the present state of our knowledge. I have introduced those that are doubtful as well as those fully

ascertained; and have arranged them in families according to my present views of their affinities—views which may however admit of important modifications when the plants shall become better known.

Summary of Fossil Plants, from beds older than the Carboniferous system, in British America and Maine.—[Described in this paper; and in that on the Devonian plants of Gaspé, in the Journal of the Geological Society of London, Vol. 15, and Canadian Naturalist, Vol. 5.]

(a).—*Exogenous Gymnosperms.*

1. *Coniferœ.*

(1.) *Prototaxites Logani*, mihi,........Lower Devonian, Gaspé.
(2.) *Dadoxylon Ouangondianum*, m.,..........St. John group.
(3.) *Sternbergia*, (probably pith of last species), Devonian, Perry.
(4.) *Aporoxylon*,........................ Do.

2. *Sigillariœ.*

(5.) *Sigillaria?—Cyperites?*.............................St. John.

(b.)—*Doubtful if Gymnosperms or Cryptogams.*

3. *Calamiteœ.*

(6.) *Calamites transitionis*, Goeppert,...............St. John.

4. *Asterophylliteœ.*

(7.) *Asterophyllites parvula*, m.,...................St. John.
(8.) *Sphenophyllum antiquum*, m.,.................St. John.

(c.)—*Acrogenous Cryptogams.*

5. *Lycopodiaceœ.*

(9.) *Lepidodendron Gaspianum*, m.,..........Gaspé and Perry.
(10.) *Lepidostrobus Richardsoni*, m.,..................Perry.
(11.) L.———.................................Perry.
(12.) *Lycopodites Matthewi*, m., ...St. John.
(13.) *Psilophyton princeps*, m.,........Gaspé, Perry, St. John?
(14.) *P.——— robustius*, m.,......................Gaspé.
(15.) *Selaginites formosus*, m.,.......................Gaspé.
(16.) *Megaphyton?*..............................Perry.
(17.) *Cordaites Robbii*, m., ...St. John.
(18.) *C.——— angustifolia*, m., ...St. John and Gaspé.
(19.) *Sagenaria?* (Knorria)..........Devonian, Kettle Point.

6. *Filices.*

(20.) *Cyclopteris Jacksoni*, m.,...........Perry and St. John.
(21.) *Sphenopteris*,...............................St. John.

Adding to the above the species from the Devonian of New York and Pennsylvania, described in the Reports of the Geology of those states, and in the Memoir of Goeppert above referred to, we may estimate the known land flora older than the carboniferous period in Eastern America, at about thirty species, belonging to at least fifteen genera, all cryptogamous or gymnospermous.

ARTICLE XI.—*On the origin of some Magnesian and Aluminous Rocks.* By T. STERRY HUNT, F.R.S., of the Geological Survey of Canada.

(*Presented to the Natural History Society.*)

In common with other observers, I have long since called attention to the fact that silicates of lime, magnesia and oxyd of iron are deposited during the evaporation of many natural waters, such as the mineral springs of Varennes and Fitzroy, and the waters of the Ottawa river. I have also suggested that the silicates thus produced may have contributed in a considerable degree to the formation of rocks. (*Amer. Jour. Science*, March, 1860, p. 284). A hydrous silicate of magnesia which approaches in composition to $MgO. SiO^3$, combined with from ten to twenty per cent of water, and mechanically mixed with small portions of oxyd of iron, alumina, and carbonates of lime and magnesia, forms extensive beds with limestones and clays in tertiary strata, in France, Spain, Morocco, Greece and Turkey. It is the sepiolite of Glocker, the meerschaum of some authors, the magnesite of others. The quincite of Berthier, which occurs in red particles disseminated in limestone, is a similar compound, containing some oxyd of iron. The sepiolite from the basin of Paris occurs beneath the gypsiferous group, and in the lacustrine series known as the St. Ouen limestone, where it forms very fissile shaly layers, enclosing nodules of opal (menilite). The structure of this sepiolite, which I have examined and described as above, and that from Morocco, which is used by the Moors in their baths as a substitute for soap, and has been described by Damour, is peculiar. The mineral is made up of thin soft scales, and when moistened with water, swells up into a pasty mass resembling a finely divided talc. Although agreeing closely with this mineral in the proportions of silica and magnesia, sepiolite contains more water, and both before and after ignition is soluble in

acids, which talc is not. We cannot however doubt that talc and steatite have been formed from sepiolite, which has undergone a chemical change and become insoluble. It is possible that serpentine may be derived from another silicate richer in magnesia than sepiolite. The frequent association of carbonates of lime and magnesia with talc, and of carbonate of magnesia, talc and serpentine, as in the ophiolite of Roxbury, would seem opposed to the notion that serpentine may have been formed from the alteration of a mixture of sepiolite and carbonate of magnesia. In chlorite, which often forms rock masses almost without admixture, we have an alumino-magnesian silicate which cannot have been derived from sepiolite, inasmuch as this contains for the amount of magnesia present, twice as much silica as chlorite. The oxygen ratios of the silica and magnesia in sepiolite are as 3 : 1, and those of silica, alumina and magnesia (including the variable amount of ferrous oxyd which in part replaces the latter) in chlorite are as 6 : 3 : 5, while in the purest clays the ratio of silica and alumina equals 1 : 1, and in most argillaceous sediments the proportion of silica is still greater. It is evident, therefore, that chlorite could not be formed from a mixture of sepiolite with clay, or even with pure alumina, without the elimination of a large amount of silica, and we are led to regard it as having been generated by the reaction of a silicate of alumina or clay with magnesia, which was probably present in the unaltered sediment in the form of carbonate. Unless indeed the process, which according to Scheerer, has in recent times caused the deposition from waters, of neolite, a hydrous alumino-magnesian silicate approaching to chlorite in composition, be the type of a reaction which formerly generated beds of chlorite, in the same way as those of sepiolite or talc.

A silicate of lime allied to sepiolite, has not so far as I am aware, yet been noticed among unaltered sediments, and among crystalline strata calcareous are more rare than magnesian silicates, although double silicates of lime and magnesia (pyroxene and hornblende,) often form beds, and wollastonite, either alone or mingled with carbonate of lime, sometimes constitute rock masses. The double silicates of alumina and lime are however abundant; the lime-feldspars, scapolite, epidote (saussurite), and white garnet, all form beds in crystalline rocks. Reactions in water at the earth's surface, and at no very elevated temperature, may have given rise to double silicates of lime and alumina corresponding to

neolite, and allied in composition to the zeolites, and these by subsequent metamorphism have been changed into anhydrous silicates. The production of harmotome, chabazite, and apophyllite by the waters of a spring at Plombières, at temperatures not above 160° F. as observed by Daubrée, lends probability to such a view.

But while we admit the possible direct formation of double silicates in water at ordinary temperatures, there is not wanting evidence that the reaction which we long since pointed out, (Proc Royal Society of London, May 7, 1857) between silicious and argillaceous matters and earthy carbonates, in presence of alkaline solutions intervenes in the metamorphism of sedimentary rocks and in the production of many silicious minerals. The blue Silurian limestones of the island of Montreal, when treated by acids leave an insoluble residue, which contains about ten per cent. of soluble silica, mixed with an argillaceous matter whose analysis gave silica 73·0, alumina 18·3, potash 5·5, and only traces of lime and magnesia. In the vicinity of an intrusive dolerite, however, the limestone is changed in colour, and leaves by the action of acids a greenish matter which consists of silica 40·2, alumina 9·3, peroxyd of iron 5·2, lime 36·6, magnesia 3.7. The free silica and that of the intermingled aluminous silicate, has thus been saturated with protoxyd bases, still however, retaining the alumina in combination. A similar reaction with more aluminous matters, would give rise to epidote, garnet, magnesian mica, scapolite or feldspars like labradorite and anorthite, and it is not impossible that in such reactions a portion of alumina may sometimes be set free, and give rise to corundum, spinel, diaspore or völknerite.

In the ordinary modes of decomposition of minerals containing alumina, this base separates in the form of silicate, and the conditions required for its elimination in a free state are but imperfectly understood. We have elsewhere pointed out the decomposition by alkaline and earthy carbonates, of solutions of sulphate of alumina or native alum, as one source of free alumina, and insisted upon the existence of pigotite, a native compound of alumina with an organic acid, as an evidence that this base is sometimes like oxyd of iron, (and oxyd of manganese,) taken into solution by water aided by organic matters. A hydrate of alumina gibbsite, is found associated with limonite, and the aluminous minerals from the south of France described by Berthier and Deville, show that free alumina is much more common

in nature than was formerly supposed. Berthier long since gave the name of bauxite to an earthy pisolitic ore which occurs either massive or imbedded in limestones of tertiary age, at Baux, and many other localities in the departments of Gard and Var, and also in Calabria, and the Grecian Archipelago, forming in some places an abundant rock.* This substance is a variable mixture of a hydrate of alumina, apparently approaching diaspore in composition, with hydrous peroxyd of iron, sometimes constituting a workable iron ore, and at other times a veritable ore of alumina. It contains besides small portions of silica, titanic, vanadic, and phosphoric acids, and occasionally encloses grains of corundum. A compact dark red variety gave Deville, alumina 57·6, peroxyd of iron 25·3, and water 10·8, besides 3·1 of titanic acid, and 2·8 of silica. In other specimens the proportions of alumina and iron oxyd are nearly equal, or the latter predominates, as in one example where the proportions were 48·8 of iron oxyd, and 32·2 of alumina; and another, 60 of iron, and 18 of alumina and titanium. In these analyses the carbonate of lime, generally present, was first removed by a dilute acid; the prolonged action of stronger, acids completely dissolves the hydrated oxyds. By an intense heat this substance is converted into crystalline corundum, resembling emery in its physical character, but the presence of grains of corundum in the hydrated mineral seems to show that the transformation may take place at ordinary temperatures. The emery of Greece and Asia Minor, which is associated with variable proportions of oxyd of iron, is according to Dr. J. Lawrence Smiths always more or less hydrated.

The argillaceous matter enclosing some varieties of this bauxite or impure diaspore, is white, without plasticity, and very rich in alumina; one specimen freed from the red ferruginous portions,gave alumina 58·1, silica 21·7, peroxyd of iron 3·0, titanium 3·2, water 14·0. This substance approaches in its composition to collyrite, and the dillmite which is the gangue of the diaspore of Schemnitz. These materials however contain from 20 to 40 per cent. of water. Scarbroite, schrotterite, and allophane are similar matters; the latter, unlike a clay in its structure, appears to have been deposited from solution. The subsulphate of alumina, known as websterite or aluminite, is often met with in layers and concre-

* Deville. *Ann. de Chime et Physique*, (3) lxi. 309.

tionary masses in tertiary clays,* and is sometimes mingled with a silicate having the composition of allophane. This frequent occurrence of alumina still retaining a portion of sulphuric acid, confirms the view which we have elsewhere expressed, that solutions of native alums have by their decomposition furnished the alumina for many of the minerals in question, while the conditions under which this base is taken into solution by organic matters, still require investigation. The careful examination of unaltered sedimentary deposits, is calculated to throw great additional light upon the origin of the crystalline rocks.

ARTICLE XII.—*On Canadian Caverns.* By GEORGE D. GIBB M.A., M.D., F.G.S. London, England.

(Extracts from a Paper read before the British Association, Sept. 1859.*)*

The prominent feature of a large portion of the province of Canada is the presence of various limestone rocks belonging to the Silurian formations. Until lately, the existence of caverns in these rocks, as well as in those lying subjacent—namely, the Laurentian of Sir William Logan, was almost unknown; as, with the exception of an isolated account here and there, no regular description of any cavern had appeared. Owing to the labours of the Canadian Geological Survey, and of several private individuals, a number of caverns have been discoved at distances remote from one another; some of these have received but a passing notice in the publications of the Survey, and are not, therefore, useful as a means of reference. The present communication it is hoped, will supply that deficiency, as in it I propose to embody, short descriptive accounts of all the caverns of Canada which are known up to the present time. The details of some of them are not so full as could be desired; nevertheless, with all the available sources of information within my reach, together with personal observation in some, on the whole the general descriptions may be relied upon as accurate, and as containing a correct account of the geological formations in which they lie.

The caverns of Canada may conveniently be divided into two classes; the first comprises those which are at the present time washed by the waters of lakes, seas, and rivers, including arched,

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* In this connection we may notice apatelite, a basic persulphate of iron, which occurs in conditions similar to aluminite.

perforated, flower-pot, and pillared rocks, which have at one time formed the boundaries or walls of caverns, and all of them unquestionably the result of aqueous action. The second comprises caverns and subterranean passages which are situated on dry land, and so far as we know, not attributable to the same causes in their origin as the first, or at least not applied in the same manner.

In the first class are included the following :—

1. Caverns on the shores of the Magdalen Islands.
2. Caverns and arched rocks at Percé, Gaspé.
3. Gothic arched recesses, Gaspe Bay.
4. The "Old Woman," or flower-pot rock, at Cape Gaspé.
5. Little River Caverns Bay, of Chaleur.
6. Arched and flower-pot rocks of the Mingan Islands.
7. Pillar sandstones, north coast of Gaspé.
8. Niagara Caverns.
9. Flower Pot Island, Lake Huron.
10. Perforations and caverns of Michilimacinac, L. Huron.
11. The Pictured Rocks, Lake Superior.
12. St. Ignatius Caverns, Lake Superior.
13. Pilasters of Mammelles, Lake Superior.
14. Thunder Mountain and Paté Island Pilasters, L. Superior.

In the second class are :—

15. The Steinhauer Cavern Labrador.
16. The basaltic caverns of Henley Island.
17. Empty basaltic dykes of Mecattina.
18. Bigsby's Cavern, Murray Bay.
19. Bouchette's Cavern, Kildare.
20. Gibb's Cavern, Montreal.
21. Probable caverns at Chatham, on the Ottawa.
22. Colquhoun's Cavern, Lanark.
23. Quartz Cavern, Leeds.
24. Probable caverns at Kingston, Lake Ontario.
25. Mono Cavern.
26. Eramosa Cavern.
27. Cavern in the Bass Islands, Lake Erie.
28. Subterranean passages in the Great Manitoulin Island, Lake Huron.
29. Murray's Cavern and subterranean river, Ottawa.
30. Probable caverns in Iron Island, Lake Nipissing.

The majority of those in the first class are on a level with the water, whilst the remainder are elevated above, varying from a few to upwards of sixty feet.

In the second class the level varies, but nearly all are above that of the sea, as will presently be described; none penetrate the earth to a considerable depth, but this may be found to be otherwise as the explorations are continued. In none have animal remains been found, excepting in one instance, and they were discovered loose and not imbedded in stalagmite; and so far as I am aware, not a single object, such as a flint arrow-head or spear, used by the ancient inhabitants of the country, has been observed. This circumstance may in some measure detract from the value of the present communication; that part of the enquiry has still to be worked out, as many of the caverns have been but very partially explored, indeed some have scarcely been examined; and as several of them branch off by means of fissures and galleries, running from distinct chambers (most of the latter containing stalag. mite), we may yet hope for interesting discoveries, particularly in that district of country in which exist the huge caverns of Mono and Eramosa in the Niagara limestone rocks of the Upper Silurian formation. The researches of Mr. Sterry Hunt, of the Canadian Geological Survey, have shown that these limestones are essentially dolomitic, and thus perhaps favourably constituted for the development of caverns.

(As examples of the caverns noticed by Dr. Gibb we take the following:— Eds.)

Caverns on the Shores of the Magdalen Islands.

On passing the interesting group of islands in the Gulf of St Lawrence, known as the Magdalens, the observer is struck with their beautiful and picturesque appearance, which is suddenly presented to his view. The cliffs, which vary in height, present equally various colours of red in which the shades predominate; these contrasted with the yellow of the sand-bars, and the green pastures of the hill-sides, the darker green of the spruce trees, and the blue of sea and sky, produce an effect, as Captain Bayfield describes, extremely beautiful, and one which distinguishes these islands from anything else in the Gulf. Such an agreeable picture it has been my own good fortune to witness and admire. The striking feature in their formation is the dome-shaped hills rising in the centre of the group, and attaining a height of from two hundred to five hundred and eighty feet. They are composed of the

Triassic or New Red Sandstone formation, which forms their base, being surmounted or topped by masses of trap rocks. The highest of the Magdalens is Entry Island, with an elevation of five hundred and eighty feet; its red cliffs rise at its north-east point to three hundred and fifty feet, and are what they have been described, truly magnificent and beautiful. The soft and friable character of the brick-red cliffs forming the shores of these islands, with their remarkable capes and headlands, have in many places yielded to the force of the waves, and have become worn into arches and caverns. This is most strikingly manifest at Bryon Island, which is nearly surrounded by perpendicular or overhanging cliffs, which are broken into holes and caverns, and fast giving way to the action of the waves. From the same cause are to be seen detached peninsular masses in a tottering state, which now and then assume grotesque forms. There is something peculiarly interesting in this singular group of islands, lying so isolated about the centre of the great Gulf of St. Lawrence; and curiosity would be well repaid by a visit from one of the neighbouring ports.

Caverns and Arched Rocks at Percé, Gaspé.

On the eastern coast of Gaspe, in the Gulf of St. Lawrence, there is a range of limestone cliffs, which commence on the south-west side of Mal Bay, at the perforated rock, called Ile Percé, and thence run in a north-north-west direction. Immediately south of these cliffs, which are six hundred and sixty-six feet in perpendicular height above the level of the sea, as described by Bayfield, are the Percé mountains, the highest of which, Mount Percé, is twelve hundred and thirty feet, and is visible forty miles out to sea.

The town "Ile Percé," as it was called in Charlevoix's time, occupies the shores of Percé Bay, running from point Percé to White Head. This writer mentions in the second volume of his "Histoire de la Nouvelle France," p. 71, that Sir William Phipps, in his expedition against Quebec, landed at Ile Percé in Sept., 1690, pillaged the town and robbed the church.

A reef connects the Percé Rock with Point Percé. This remarkable perforated rocky islet, which gives the name of Percé to this locality, is two hundred and ninty-nine feet in height, precipitous all round, and bold to seaward. This islet and the island of Bonaventure are considered outliers of the conglomerate rocks

which enter into the formation of the main land at Percé, the former would seem especially to be a continuation of the range of cliffs on the south-west side of Mal Bay. The Split Rock is an almost inaccessible mass of this strata, and stands up like a wall, in continuation of the limestone-cliffs of Barry Cape (Point Percé). It is five hundred yards long, one hundred broad, and is remarkable for the presence at its western half of two large holes or arches, through one of which a sloop at full sail can pass at high water. There is a lateral arch at the north east side, scarcely perceptible from the water.

The perforations in this rock have been formed by the action of the waves of the sea, the same cause which has in the progress of time effected the disjunction of these outliers from one another and the main land. From the present position of the islet, which lies almost north and south, I am disposed to consider its northern aspect as the oldest, the two arched openings at that side forming what were once the entrance to deep caverns running into the rock southwards, which in the course probably of ages has been washed away by aqueous denudation. This view is strengthened by an examination of the intervening shores as they exist at present. The coast line of Ile Percé runs along to Bonaventure Island, with an imaginary position of the land at one time between the south-west part of the latter island and the shore at the Bay of Percé, at the point where the cliffs commence at its southern third. This gives the southern coast a semicircular course, with a low shelving beach corresponding to that which now exists at Percé Bay on the one side, and the western coast of Bonaventure on the other; whilst the northern coast is rocky and precipitous, probpierced with many caverns, and gradually diminishing in height to the southward.

Bouchette's Cavern, Kildare.

This cavern was visited and first described by Colonel Bouchette (Surveyor-General of Canada) in the report of his official tour though the new settlements of the lower province in 1824. It is situated in the township of Kildare, about thirty-five miles due north of the city of Montreal, but the precise locality I have been unable to determine, although from the description it may be close to the village of the same name. The southern part of the township is traversed by a broad band of the Potsdam sandstone, in continuation of the same rock running in a north-east direction

from the south-western part of the township of Rawdon. That part of Kildare north of this band is composed of gneiss of the Laurentian system most probably interstratified with some bands of crystalline limestone, in which the cavern is developed.

It was about the year 1822 that two young Canadian peasants, whilst prosecuting their sport of hunting the wild cat, pursued two of their game, until entering an obscure hole a little above the bank of the river, they lost sight of them. The more enterprising of the two attempted to enter the aperture in the rock, at that time barely sufficient to admit of his crawling into it, but without success. Providing themselves with lights, a second attempt was more successful, "for not only did they secure their prey (of which they have preserved the skin to this day), but they discovered," says Colonel Bouchette, "another of the many phenomena of nature, a description of which cannot be uninteresting."

The following account is given in the Colonel's words :—

"I descended into the cavern by means of a trap-door, which has recently been placed at one of its angles for the facility and convenience of strangers desirous of visiting this singular spot, having as my guides two of the inhabitants of the neighbouring house, bearing lighted tapers. The height of the cave where we entered is five feet, from which angle branch off two caves, the lesser whereof is of the following dimensions :—

Length......................		25 feet
Breadth varying from..........	$2\frac{1}{2}$ to	9 "
Height......................		5 "

It bears about a south-east course from the entrance.

The other has in length......		70 feet.
Width from..................	7 to	8 "
Height gradually increasing. ..	5 to	13 "

"The increase in the loftiness of the cave originates from the declivity of the ground part, which, at the north-eastern extremity, is at least twenty-three feet from the surface. It forms nearly a right angle with the first, at its south-western end, and an angle scarcely obtuse at the other with another cave, whose

Length is...................	80 feet
Average width................	6 "
Height......................	5 "

At the south-eastern extreme of this cave branches off another of inferior size and consequence, bearing about a due north course,

as may be deduced from the angle it makes with the last describ·ed :—

It is in length................	20 feet
Width......................	5 "
Height......................	5 to 4 "

"At the outward angle formed by this cave with the preceding one, is to be seen a nearly circular aperture of about a foot and a half in diameter, which leads to a cavern yet unexplored, the extent whereof is not known with any certainty; but conjecture and supposition will have it to extend two arpents—an astonishing distance as a natural subterraneous passage. Summing the lengths of the several caves above-mentioned together, we have a total distance of a hundred and ninety-five feet of subterrancity in the solid rock offering a beautiful rock of crystallized sulphurate of lime, carved as it were by the hand of art, and exhibiting at once the sublimity of nature, and the mastery of the all-powerful Architect of the universe."

From the foregoing description there would seem to be five different caverns or galleries, and probably many more, if the fifth has been since explored. Three of them branch off from the entrance in different directions, whilst the remaining two do so at the termination of the central gallery. The roof throughout is covered with stalactites, but as no mention is made of stalagmite, nor of the presence of bones, we are left to conclude that they were absent, although the chances were much in favor of finding the latter, in consequence of there being a free and unobstructed entrance into the cavern.

ARTICLE XIII.—*Flint drift and Human Remains. Extacted from the Duke of Argyll's opening address as President of the Royal Society of Edinburgh.*

(From the Edinburgh New Phil. Journal.)

"The attention, not of geologists only, but of men of science in several departments, has, during this and the preceding year, been fully awakened to the importance of a discovery which is really of much older date—viz., that flint implements, the work of man, are found in beds of drift gravel associated with the bones of the last generation of the great extinct mammalia. The full significance of this fact is only now being fully recognized, and many of the conclusions which it may tend to establish are subject to much doubt,

and will probably form the subject of increasing controversy. But it is only necessary to have a clear idea of the facts as they have been now ascertained, to see that one conclusion at least is placed beyond all question—viz., that great physical changes on the surface of the earth, and these, in part at least, effected by the agency of water, have taken place since the creation of man.

Whether this conclusion carries the creation of man farther back than had commonly been supposed, or whether it merely brings nearer to us than we had before conceived the last great changes which have produced the existing surface, is the main question on which debate arises. As geology gives no certain data for computing positive, but only relative time, this question is necessarily involved in much obscurity. But there are certain limits within which, after all, the controversy is confined. It is well to observe that, according to the principle on which geological times and epochs are classified, the human epoch remains, after these discoveries, very much where it stood before. It is true that many of the large animals, with which the traces of men seem to be connected, are now extinct; but a very much larger number are still living. The Molluscan Fauna, which plays so important a part in ages of geologic time, is absolutely the same. The general aspect of animal life is the present aspect, with the exception that a certain number of species of the larger Herbivora and Carnivora have become extinct. But such extinctions, local in many instances, and total in some, have taken place in historic times, and are in visible process of accomplishment even now. Such extinctions do not constitute a new Fauna, nor, according to the received principle of classifying past times, do they mark a new geological age. The era of man, therefore, remains, geologically speaking, in the same relative place in which it stood before—the very last and latest of the world.

But the fact that human implements are found under great beds of gravel and of earth formed by water, whether of rivers or of the sea, at an elevation which in either case would imply changes of level, such as, if general, would be enough to revolutionize the whole aspect of our now habitable surface, is a fact which casts new and important light on the (geologically speaking) very recent date at which those changes have taken place.

Whether the men who formed the implements were or were not contemporary with the living quadrupeds whose bones are associated with these implements, seems to me a subordinate ques-

tion. The mere fact of such association may not absolutely prove the point, because it is conceivable that the bones may have been merely re-aggregated from an older fossiliferous deposit. But I suspect that the reluctance to admit the contemporaneity of man with those animals results from the reluctance to admit man's priority to such physical changes as are supposed to separate us from a Fauna typified by the Mammoth and the Elk. If, therefore, the fact of such priority be proved from the stratigraphical position of the flint relics, wholly independent of any argument derived from organic remains, the importance of the question respecting the human age of the great mammals will be much diminished. It may be well, therefore, to keep our attention firmly fixed on what is really the important question—the nature and position of the strata in which, and under which, the flint implements have been interred. Going no farther for light upon this question than the particular beds at Amiens and Abbeville in France, where the implements have been found in greatest abundance, it is enough to record the fact. The flints are embedded in a stratum of gravel, which rests directly on an eroded surface of the chalk, and contains along with the hatchets, the bones of the great extinct mammalia. This is again surrounded by a bed of sand from seven to ten feet thick, in which only a few rare bones and implements have been found. This is again capped by a second bed of gravel from two to five feet thick; and lastly, on the top of all, is a bed of brick earth, in which, as if to afford the very poetry of illustration, are to be seen the tombs of Roman-Gaul. Such is the position of the beds with reference to each other. But what is their position with reference, not to each other, but to the surrounding country? The gravel-bed extends to points upwards of a hundred feet above the level of the river Somme, which occupies the bottom of the existing valley. It is described by Professor Rogers, a most competent and accurate observer, as extending to the summits of the plateaux which determine the existing drainage. Whether, therefore, the water which formed these beds were marine or fluviatile, in either case such changes of level are implied as would be sufficient, if general, to alter widely the existing distribution of land and sea.

Here, then, the question arises, Were those changes local—confined perhaps to the district of Western France? Connected with this question, another immediately occurs: Is not this bed of gravel identical in character and compositson with similar deposits

in other countries? Is there anything to distinguish it from the gravels containing precisely the same mammalian bones which are familiar to geologists in almost every country, and which have been recognized every here and there over the whole of Europe, from Siberia to Palermo, and from the basin of the Thames to the valley of the Danube? So far as I have been able to gather from the papers which have detailed the facts, there is nothing to indicate any difference whatever, except that, at least until this discussion arose, human implements had nowhere else been recognised as associated with the drift. The absence of such remains elsewhere, however, would go for little in establishing a difference because it is clear that the men who existed before the formation of the Abbeville beds were rude, and probably widely scatttered savages, distant outliers of their race. The chances therefore, were infinite against the preservation either of them or of their works. But even this distinction, it would appear, is being broken down. It is now recollected that so long as sixty years ago, human implements had been discovered in Suffolk under similar conditions, and the fact communicated to the public in an archæological journal by the discoverer Mr. Frere. The spot has been visited by Mr. Prestwich, fresh from the Abbeville beds, and he recognises the same phenomena. But this is not all. The scent, once taken up, is becoming stronger and stronger, every day. Closely connected with the period of the drift-gravels are the ossiferous caves and caverns so common all over Europe where limestones prevail. They have been long known to contain a profusion of bones cf the extinct as well as of living mammalia. Here, again, it is now confidently asserted that human implements are being found under conditions which leave no doubt that, whether man was or was not contemporary with these animals, he must at least have preceded the action of these agencies which brought the bones together. The evidence in this case must necessarily be more liable to erroneous interpretation than in the case of implements found in undisturbed beds of gravel, because caverns must at all times have been a resort of savage tribes whenever the entrances were accessible from the surface. But the evidence seems to be such as is sufficient to convince examiners so careful and acute as Dr. Falconer and Mr. Prestwich of the undoubted priority of man to that diluvial action which appears to have swept into those caverns their mixed contents. But this is not all. It

is now recalled to mind, that so long ago as 1833, a M. Schmerling had published Researches into the Ossiferous Caverns of Belgium, in which, not implements of man only, but his teeth and his bones, and portions of his skull, had been found so thoroughly mixed up with the remains of the lower mammalia as to leave in his mind no doubt, if not of their contemporaneous life, at least of their contemporaneous entombment in the spots where they are now found. These are remarkable facts; and in so far as they indicate that the phenomena of Abbeville are closely related to others observed in many different parts of Europe, they go far to prove that the French gravel-beds were due to no mere local cause, but to some diluvial action which was general, and therefore in all probability due in great part to the waters of the sea.

I need not point out how many and how interesting are the questions which this discovery raises in our minds. Was this incursion of the waters of the sea, over a pre-existing land, sudden and transient, or gradual, and of long duration? In the Abbeville beds there seems to be clear evidence of four successive stages of submergence, each distinguished from the other by different mineral conditions. The first bed, that in which the bones were entombed along with the human implements, indicates an action strong, if not violent, but not of long duration. The second indicates, by its finer materials, the action of a gentler force. The third seems to be very much a repetition of the first; whilst the last can only be accounted for on the supposition that fine sediment had time to accumulate in comparatively tranquil waters. The interest of the question is very much centred in the nature of the action which began this series of events. Perhaps it may be well to look at the conclusion come to in respect to the origin of the mammaliferous drift-gravel by the geologist who has devoted most special attention to the subject, and before the discoveries of Abbeville had disturbed any preconceived idea. I find Mr. Prestwitch, in a lecture delivered in 1857, coming to this conclusion in respect to the ossiferous gravels of the Thames:—"Taking into consideration the absence of contemporaneous marine remains, and noting the immense mass of but slightly worn débris derived from and covering irregularly the sedimentary deposits; and the fact that it has evidently been transported from greater or less distances, combined with the occurrence in the gravel of the remains of large land-animals, of trees, and of fresh-water land-shells

we have, I conceive, at all events in these facts, indications of at least one land-surface here destroyed, and its rocks, plants, and animals involved in one common wreck and ruin."

An able and elaborate paper on the "Distribution of the Flint-Drift of the South east of England," &c., was communicated to the Geological Society of London by Sir R. Murchison in 1851. The phenomena he describes seem everywhere to be a precise repetition of those of Abbeville. Everywhere the flint drift, which is often, as there, covered by brick-earth, clay, or loam, is characterised by the bones of the great extinct mammalia, and everywhere, according to the author's view, gives evidence of sudden and violent diluvial action. Everywhere also, this drift-gravel rises high above the levels of the existing drainage, whilst, at the same time it gives evidence that the general configuration of the surface was substantially the same as now. Everywhere, also, wherever shells have been preserved, they belong to our existing fauna, and thus prove beyond a doubt that, geologically speaking, the age of the drift is the age of the existing world. "In short," he says, "the cliffs of Brighton afford distinct proofs that a period of perfect quiescence and ordinary shore action, very modern in geological parlance, but very ancient as respects history, was followed by oscillations and violent fractures of the crust, producing the tumultuous accumulations to which attention has been drawn."

Unless, then, the Abbeville beds can be separated from those so widely prevalent in other countries, the discovery of human implements underneath this drift will rather tend to bring nearer to us than had ever been supposed some great and sudden diluvial action, than to cast any very clear light on the absolute time—that is, on the time measured by years or centuries—which has elapsed since the creation of our race. The facts which have been brought to light prove, indeed clearly enough, that since man walked the earth some great changes have affected the condition of its surface; and it is impossible as yet to say what bearing this discovery may be found to have on that remembrance of at least one great catastrophe, which is not more a part of sacred history than it is of profane tradition.

We must not, however, shut our eyes to the indirect effect which this discovery must have on the question of positive time. In the first place, there is a school of geologists, led by our distinguished countryman Sir Charles Lyell, who disbelieve generally in these

conclusions which point to violent and sudden changes; and, in the next place, it must be remembered that changes which in point of geological time might well be accounted rapid, might nevertheless well occupy thousands of our years. There is proof in these gravel beds of the Somme of a double motion, one of submergence to the depth of certainly more that 100 feet, another of subsequent elevation, during which the immense mass of material which had been brought down and deposited by water, has been worn through and broken into escarpments, either by the existing stream or by more powerful currents. We have no data from which to measure in years the time which the accomplishment of such a series of changes may imply. But I think the general impression left upon the mind must be in favour of a very high antiquity. Farther light may be cast upon this subject if the drift-gravels of France, the south of England, and other countries can be co-ordinated with any one of the stages of operation to which we owe the superficial deposits of Scotland and the north of Europe generally. It is well known that in these last there is one prominent charactercstic which is absent farther south. I mean the abundant proofs of glacial conditions, or an arctic climate. On this subject there is a paper of great interest in the last "Quarterly Journal of the Geological Society," by Mr. Jamieson, founded on observations made mainly in the county of Aberdeen. The cycle of changes which this geologist thinks can be clearly traced, as necessary to account for the superficial deposits of our own country, amount to no less than five great epochs, including two of submergence and two of elevation, and involving changes of level to the extent of more than 2000 feet. Scotland has long ago furnished evidence as clear as that founded on the French flint implements, that at least previous to the last of these elevations man had reached her shores, and navigated her rivers and estuaries in those rude canoes, hollowed out of trunks of oak by stone hatchets, which have been frequently found in elevated beds of silt and gravel in the valley of the Clyde. And here we strike upon evidence which has some bearing upon the question of time. Closely connected with the period preceding the last elevation of the land, we have proof that an arctic climate prevailed over a large part of the northern hemisphere, whose climate is now comparatively temperate. But this period seems clearly to have been one of long duration—that is to say, of such duration, and lasting

under such conditions of comparative rest, as to allow the development of a glacial fauna. Close to my own residence on the Clyde each low ebb exposes numerous examples of the *Pecten Islandicus* and of those very large *Balani*, which are confined to arctic seas. These beds of shells, which are all of existing species, but of species which have retired from our now more genial temperature to a northern habitat, were first described by my friend Mr. Smith of Jordanhill, and his observations and conclusions have since been abundantly confirmed. We have no knowledge how this period was brought to a close. But there seems to be evidence that it had come to an end, and that for a long time before the last elevation of the land, and before man had appeared in Scotland. This seems to be a legitimate deduction from the fact that the canoes in the elevated Clyde beds are formed of oak of large dimensions and of great age. Forests which afforded such timber must have flourished in a climate not much more rigorous than that which exists at present. Here again, then the earliest footprints of our race are traced up to a point, preceding indeed some important physical changes, but clearly subsequent to the establishment of all the main conditions which now affect the distribution of animal and vegetable life.

As regards the extinction of some animals, I have spoken as if the contemporaneousness of man with them whilst yet living ought not to be absolutely assumed merely from the fact that his implements are associated with their bones. But on this point new evidence is being rapidly collected and brought together. Mons. Lartet, a distinguished French naturalist, has found what he considers to be a distinct evidence of the mark of human weapons on various parts of the skeletons of the extinct mammalia of the drift. These marks have been detected on the skull of the *Megaceros Hibernicus*, or great Irish elk—an animal which stood some ten feet high—on the bones of the *Rhinoceros tichorinus*, and on those of various species of the ox and deer, which are now either extinct or confined to the last remnants of a declining race. The marks are of various kinds—some of them peculiar—indicating a sort of sawing with some instrument not of the smoothest edge. M. Lartet has ascertained that these blows and cuttings could not be made except on fresh bones—that is to say, on bones undried and retaining their animal cartilage. Farther he has succeeded in producing on the bones of existing animals precisely

the same peculiar forms of incision by using one of the old flint implements found in the same beds of gravel, whilst he has equally found that similar marks are incapable of being produced by implements of metallic edge. His conclusion is thus stated by himself:—"If, therefore, the presence of worked flints in the diluvial banks of the Somme, lone since brought to light by M. Boucher de Perthes, and more recently confirmed by the rigorous verifications of several of your learned fellow-countrymen, have established the certainty of the existence of man at the time when those erratic deposits were formed, the traces of an *intentional* operation on the bones of the rhinoceros, the aurochs, the megaceros, the cervus sommensis, &c. &c., supply equally the inductive demonstration of the contemporaneousness of those species with the human race."

The great number of flint implements which have been found in the French beds—said to amount to upwards of a thousand in a few years—when compared with their great rarity elsewhere, is not perhaps so curious as at first sight it may appear to be. Flint implements can only be made where flints are accessible; and it is well known that the flints of particular beds, or strata of the chalk, are more easily fashioned than others. It is therefore probable that some such favourable locality had existed in the chalk of that part of France, and that what may be called a manufactory of them had been established there. It is remarkable that some of the implements are only half finished, whilst all of them exhibit such sharp edges and angles as are sufficient to prove that they have not been transported far from the spot where they were made, nor subjected to long wear from use.

On the whole, then, it is not to be doubted that the discovery of human implements under repeated beds of aqueous drift and and sediment, so high above the levels of exising rivers, or of the existing sea, is a fact of very great significance and importance. In its bearing on geology, it is principally interesting as proving at how recent a period portions at least of the earth have been subject to powerful and rapid diluvial action. In its bearing on human chronology, everything depends on the degree of suddenness and rapidity with which water may have been brought to act upon the former surface. But here anything like data for positive computation entirely fails us. We have no knowledge, in historic times, of any aqueous operation on so grand a scale. Making

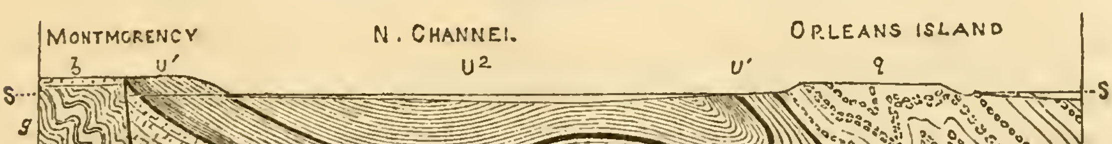
however, every deduction which can be made, we must be prepared to find that the facts thus brought to light in the valley of the Somme will be held to furnish important collateral evidence in support of the reasoning founded on other sciences, such as philology and ethnology, which has long demanded, for the development of our race, a number of years far exceeding that which is allowed by the chronology previously received. It is the beautiful expression of Sir Thomas Browne, which I find quoted by Dr. Mantell in a former paper on this subject, that "Time conferreth a dignity upon the most trifling thing that resisteth his power:" and it is impossible to look at these rude implements—perhaps the earliest efforts of our race, in the simplest arts of life—without being impressed with the high interest of the questions with which they seem to be inseparably connected.

ARTICLE XIV.—*Considerations relating to the Quebec Group, and the Upper Copper-bearing rocks of Lake Superior.* By SIR W. E. LOGAN, F.R.S., Director of the Geological Survey of Canada.

(Read before the Nat. Hist. Society.)

In a communication addressed by me to Mr. Barrande on the fauna of the Quebec group of rocks, (Canadian Naturalist and Geologist vol. v. p. 472), after showing that the organic remains discovered last year at Point Lévi placed the group about the horizon of the Calciferous formation, I stated that the apparent conformable superposition of the group on the Hudson River formation was probably due to an overturn anticlinal fold or overlap.

Fig. 1.



g, Laurentian gneiss.	*q*, Quebec group.
b, Trenton limestone.	*F*. Fault.
u^1, Utica shale.	*O*, Overlap.
u^2, Hudson River shale.	*S*, Level of the Sea.

Horizontal and vertical scale, 1 inch to 1 mile.

The character of this overlap is exhibited in the accompanying wood cut (fig 1) of a vertical section in the neighbourhood of Quebec, extending from the Montmorency side of the St. Lawrence across the north channel and the upper end of the Island of

Orleans. The road from Beauport to the Montmorency runs over a floor of Trenton limestone, which has a very small dip towards the St. Lawrence; farther back from the river the rock has a gentle dip in an opposite direction giving evidence of a very flat anticlinal form, which could scarcely be detected without the aid of the general distribution of the formations in the neighbourhood. On the south side of the road there occurs a dislocation which can be traced the whole way from Beauport church to Montmorency falls, where the effect it produces is easily discernible. Here the channel of the Montmorency is cut down through the black beds of the Trenton formation to the Laurentian gneiss on which they rest, and the water at and below the bridge flows down and across the gneiss, and leaps at one bound to the foot of the precipice, which immediately behind the water is composed of this rock. At the summit the Trenton beds are seen on each side; on the right bank they have a thickness of about fifty feet, and are marked by the occurrence of *Leptœna sericea* (Sowerby), *Strophomena alternata* (Conard), *Orthis testudinaria* (Dalman) *Lingula crassa* (Hall), *Conularia Trentonensis* (Hall), *Calymene Blumenbachii* (Brongniart), and *Trinucleus concentricus* (Eaton). The dip of these beds is down the stream at a very small angle; but at the foot of the precipice and immediately in contact with the gneiss, about the same thickness of black limestone is tilted up to an angle of fifty-seven degrees; it is followed by about an equal amount of black bituminous shale with the same slope. In this attitude these rocks climb up the face of the precipice presenting their edges to the chasm on each side; they are succeeded by about eight feet of hard grey sandstone weathering brown in beds of from ten to eighteen inches, interstratified with black shale; on this repose gray arenaceo-argillaceous shales composing the sides of the chasm out to the waters of the St. Lawrence, the distance being about a quarter of a mile, and the dip which is towards the St. Lawrence by degrees diminishing to about thirty-five degrees.

These tilted beds are fossiliferous, the species contained in the limestones being *Stenopora petropolitana* (Pander), *Ptilodictya acuta*, (Hall), *Strophomena alternata*, *Leptœna sericea*, *Orthis testudinaria*, *Camerella nucleus* (Hall), *Lingula* allied to *L. obtusa*, *Descina crassa* (Hall), *Bellerophon bilobatus* (Sowerby), *Conularia Trentonensis*, an undetermined *Orthoceras*, *Cyrtoceras constrictum* (Hall), *Calymene Blumenbachii*, *Cheirurus pleurexan-*

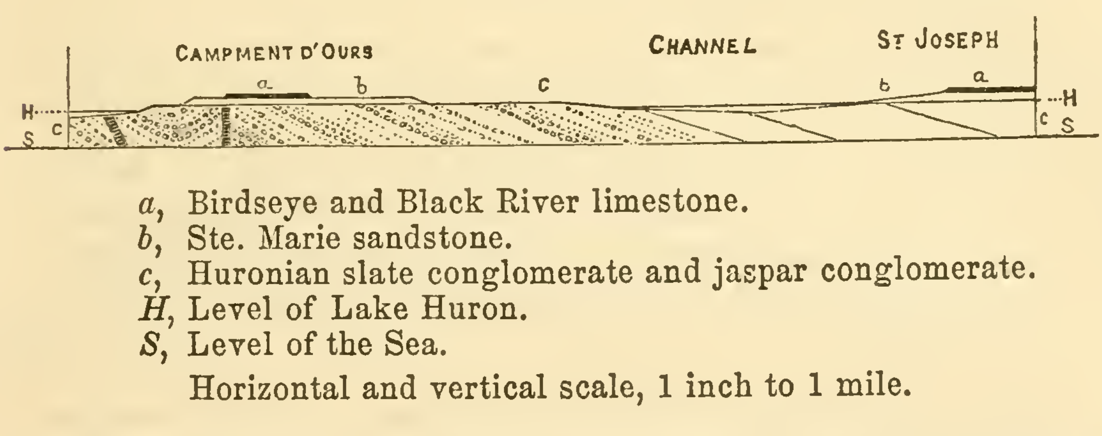
ERRATUM.

Page 201, line 12, for "They dip S.W.," *read* "They dip S.E."

themus (Green), *Trinucleus concentricus*, *Asaphus platycephalus* (Stokes); those contained in the black shales are *Graptolithus bicornis* (Hall), *G. pristis* (Hessinger). There is thus no doubt whatever that the limestones are of the Trenton and the shales of the Utica formation.

On the opposite side of the north channel at the upper end of the Island of Orleans there occur about 500 feet of black bituminous shale interstratified with occasional beds of gray yellowish-weathering calcareous sandstone, and arenaceous limestone; they in some parts hold *Graptolithus bicornis* and *G. pristis*, and there is little doubt are subordinate to the Utica or Hudson River formation. They dip S. W. $< 50°$, and there rests upon them (the contact being visible) a series of magnesian shales and conglomerates dipping in the same direction and at the same angle. These magnesian strata are of the same character as those at Point Levis, and belong to the Quebec group. They thus overlap the black shales which are probably overturned as represented in the diagram (fig. 1).

Fig. 2.



a, Birdseye and Black River limestone.
b, Ste. Marie sandstone.
c, Huronian slate conglomerate and jaspar conglomerate.
H, Level of Lake Huron.
S, Level of the Sea.
Horizontal and vertical scale, 1 inch to 1 mile.

In his explorations of last year on Lakes Superior and Huron Mr. Murray ascertained that the lowest rock in that neighbourhood well characterised by its fossils belongs to the Birdseye and Black River group, and that it rests conformably upon the sandstones of Sault Ste. Marie. These sandstones and their equivalents, consisting of red and yellowish-white beds, are traceable on the south side of Lake Superior from Marquette to the River St. Marie and compose Sugar Island and probably the north part of Neebish Island; they extend to the north part of St. Joseph Island, and are met with on the Island of Campment d'Ours. In one of the white beds near Marquette, Mr. Murray obtained a *Pleurotomaria* resembling *P. Laurentina* of the Calciferous formation and observed the occurrence in the same bed of a species of *Scolithus*. The mass

on Campment d'Ours is of the same color and friable character as the yellowish-white beds near Marquette and is marked by the same *Scolithus*, and there is little doubt that the two exposures are of the same series. On Campment d'Ours the sandstone reposes on the Huronian series; it is eighty feet thick and is very nearly horizontal, (fig. 2.) It is succeeded in ascending order by the following series of beds :—

Bluish-gray shales interstratified with thin beds of yellowish compact limestone, presenting an escarpment over the sandstone; the fossils observed are *Stenopera fibrosa, Ptilodictya fenestrata, P. acuta, Strophomena alternata, Rhynconella plicifera*, and a small undetermined *Lingula*..	20
Measures concealed..	60
Ash-gray compact limestone in beds of from three to five inches thick, interstratified with a five-inch bed of drab colored compact limestone; among the fossils are *Stenopera fibrosa, Glyptocrinus ramulosus, Strophomena alternata, Pleurotomaria subconica, Subutiles elongatus, Ambonychia amygdalina, Cyrtodonta Huronensis, Vanuxemia inconstans, Orthoceras tenuifilum, O. Murrayi, Leperditia Canadensis, and Asaphus platycephalus*..................................	4
Ash-gray compact limestones in beds of from four to six inches, underlaid by a dark brownish-gray arenaceous limestone bed of about ten inches, and divided by thin layers of gray calcareo-argillaceous shale; all the strata are very fossiliferous, and the species they contain are *Glyptocrinus ramulosus, Ptilodictya multipora, Coscinium flabellatum, Strophomena alternata, S. filitexta, Rhynconella recurvirostra, Orthis subequata, Vanuxemia inconstans, Cyrtodonta Huronensis, C. subcarinata, Pleurotomaria subconica, Trochonema umbilicata, Murchisonia perangulata, Orthoceras recticameratum, Cheirurus pleurexanthemus, and Leperditia Canadensis*	30
Ash-gray compact limestone of the same character as the preceding, but still more fossiliferous; the beds contain *Tetradium fibratum, Stenopora fibrosa, Columnaria alveolata, Petraia profunda, Strophomena alternata, S. filitexta, Rhynconella recurvirostra, Ambonychia amygdalina, Cyrtodonta Canadensis, C. Huronensis, C. mytiloidea, Vanuxemia inconstans, Ctenodonta nasuta, Pleurotomaria subconica, Eunema strigillata, Subulites elongatus, Orthoceras tenuifilum, O. Murrayi*, an undescribed *Cyrtoceras, Asaphus platcycephalus, and Leperditia Canadensis*	16
	130

The fossils of these limestones leave little doubt that they belong to the Birdseye and Black River group, and the underlying sandstones and other rocks, constituting the upper copper-bearing series of Lake Superior, may thus represent the Chazy, Calciferous, and Potsdam formations and be equivalent to the Quebec group and the black shales and limestones beneath.

This equivalency and the disturbance which brings the Quebec group to the surface (the course of which disturbance has already been given in the communication addressed to Mr. Barrande) suggest the following considerations.

From the occurrence of wind-mark and ripple-mark on closely succeeding layers of the Potsdam sandstone where it rests immediately upon the Laurentian series, we know that this arenaceous portion of the formation must have been deposited immediately contiguous to the coast of the ancient Silurian sea, where part of it was in some places even exposed at the ebb of tide. No want of conformity is known to exist between the Potsdam and Calciferous formations, and the Quebec group being of Calciferous age and 7000 feet thick, it follows that during the Potsdam period, while the typical sands of the formation were on a level with the surface of the sea, there must have existed a depth of water of at least 7000 feet over the area on which were subsequently deposited the strata of the Quebec group.

As constituting the great metalliferous formation of the continent this group is traceable under various designations from Gaspé to Alabama, thence sweeping round on the west side of the Mississipi through Kanzas to Lake Superior, without suffering any diminution in its volume, thus forming the measure of a deep sea in the course indicated, and probably still farther to the Arctic ocean. Within this line northward in so far as Canada is concerned, we find a marginal outcrop of these rocks of only a few feet in thickness on the north coast of Lake Huron from Lake Superior to Lacloche. Including the Potsdam sandstone they are altogether absent between Lake Huron and the neighbourhood of Kingston. In the area between the Laurentide and Adirondac Mountains, from a line between Lake Ontario and the Lac des Chats eastward to Lake Champlain on the one hand and the St. Maurice on the other, the united thickness of the Potsdam, Calciferous and Chazy formations scarcely attains 1000 feet. With the exception of a small mass of the Potsdam sandstone at St. Ambroise near Quebec, we have no evidence of a marginal outcrop of the formation between the St. Maurice River and the Mingan Islands, while a similar outcrop of the Calciferous and Chazy formations has not been observed from the longitude of Lake St. Peter to the same group of islands; in these islands themselves the thickness of the three formations does not exceed

500 feet, but beyond this we are not yet sufficiently acquainted with the Lower Silurian rocks to make any statement.

From these facts however it would appear probable that during the Potsdam period the older rocks which formed the coast of the Lower Silurian sea extended under comparatively shallow water south-eastwardly from the St. Lawrence and Ottawa to the position of the fault which brings the Quebec group to the surface between Gaspé and the Mohawk river, and south-westwardly from a line between the Mohawk and Lake Superior as far as Alabama. From this shallow area they descended quickly into deep water all around, thus constituting a subaqueous promontory from the so-called azoic rocks of the north-east, and forming with them what Professor Dana I believe has termed the nucleus of the North American continent.

But though the volume of the Quebec group makes it apparent that over the area occupied by it and the subjacent black shales, there must during the Potsdam period have existed a deep sea, it is yet to be remarked that many of the members both of the lower and upper parts of the group have by no means the character of deep sea deposits. To obtain the conditions required for the accumulation of the coarser members of the series, which commence near the bottom of the group, it must be supposed that about the beginning of the Calciferous period, a great continental elevation occurred, carrying the shallow water deposits of the Potsdam high above the sea and bringing the area at the base of the Quebec group comparatively near the surface. The successive coarse deposits of the group indicate a subsequent gradual subsidence at unequal intervals until the early shallow water strata were again submerged, to be first partially covered over by deposits of the Chazy formation, and then almost universally by those of the Birdseye, Black River and Trenton.

In this way may be accounted for the break which occurs in the succession of life between the Calciferous and Chazy, in the development of the latter formation between the Allumette Island and Montreal, as well as among the Mingan Islands; and the break in the succession of deposits between the Potsdam and Birdseye at St. Ambroise, between the Laurentian and Birdseye from the north shore of Lake Huron to Kingston, in the vicinity of Bay St. Paul and of Murray Bay, and in Lake St. John on the Saguenay.

The break in the succession of life between the Chazy and Birdseye, is not so great as that between the Calciferous and Chazy. It is not yet quite certain that in Canada a single species passes upwards in the latter case, while in the former, the proportion which does so is about one-sixth. It seems to be in accordance with this, that we have evidence of a somewhat sudden submergence for the introduction of the Birdseye and Black River group, and a somewhat rapid accumulation of its deposits. Where these rest upon the Huronian and Laurentian series, the beds of contact are often composed of angular fragments of the rock beneath, and it frequently happens that the surface on which these beds rest, is rough and uneven, broken into sharp projecting ledges and deep fissures, which have been filled up and covered over by the deposits in question, before sufficient time had elapsed to permit the asperities of the bottom to be worn to a smooth surface.

An instance in illustration of this occurs on the Snake Islands, west of Lacloche in Lake Huron, where the Birdseye and Black River group rests on the quartzites of the Huronian series, and the lowest bed of the group is made up of angular fragments of the quartzites cemented together by the fossiliferous limestone; there is another at Marmora, where the same group, supported by Laurentian rocks, fills up deep angular cavities in the surface. Dr. Dawson has pointed out a striking instance of the phenomena at Hog Lake, in Huntingdon; others occur at Sloat's Lake in Loughborough and places adjacent, as well as at Kingston Mills, and the same phenomena are observable in the neighbourhood of Murray Bay.

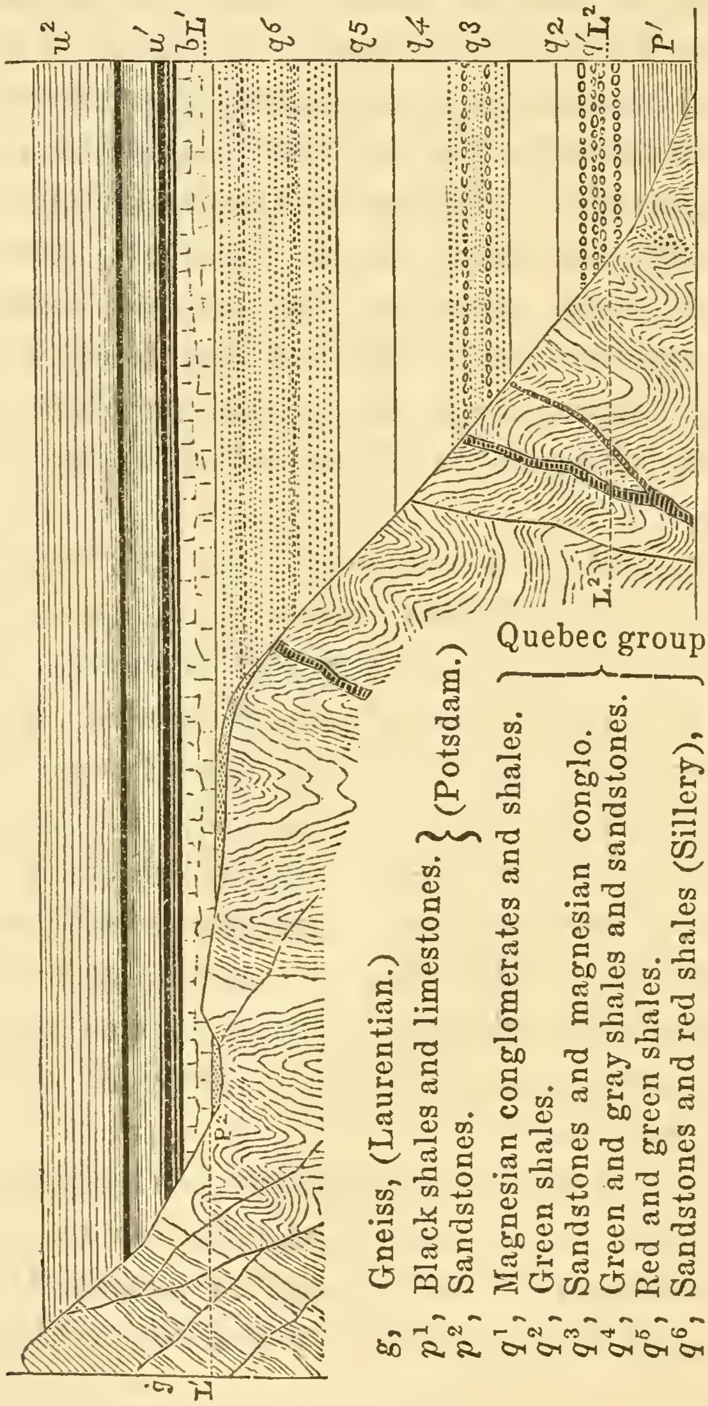
As an instance of the probably rapid slope with which the bottom of the Lower Silurian sea descended from shallow to deep water during the Potsdam period, in the neighbourhood of Quebec, we see that the surface of the gneiss now supporting the Trenton formation at the Falls of Montmorency, must have been as much as 7000 feet above that under the Island of Orleans, where the Quebec group makes its appearance, while the distance between the two positions does not exceed a mile and a half; this would give a slope of nearly forty-five degrees, and perhaps it would not be extravagant to take it as more or less typical of the slope on the whole line to Alabama.

As the black shales and limestones subordinate to the Potsdam and the deposits of the Quebec group accumulated, the

edges of the strata would abut against this slope, and ultimately both they and the early shallow water deposits on the higher terrace would be covered over by the Birdseye, Black River, Trenton, Utica, and Hudson River formations, as represented in the accompanying diagram, (fig. 3.)

Fig. 3.

Scale, 1 inch to 1 mile.



g, Gneiss, (Laurentian.)
p^1, Black shales and limestones. } (Potsdam.)
p^2, Sandstones.
q^1, Magnesian conglomerates and shales.
q^2, Green shales.
q^3, Sandstones and magnesian conglo.
q^4, Green and gray shales and sandstones.
q^5, Red and green shales.
q^6, Sandstones and red shales (Sillery),
b, Limestones (Birdseye Black River and Trenton.)
u^1, Black Shales (Utica.)
u^2, Dark gray shales and sandstones, (Hudson River.)
L^1, At the level of the sea during the Potsdam period.
L^2, " " at the commencement of the Calciferous.

Without enquiring into the origin of the forces which have produced the corrugations of the earth's crust, we may suppose that if a sufficient lateral pressure were applied to strata thus accumulated and arranged, there would result a set of parallel folds and overlaps, running in a direction at right angles to that of the pressure, with prevailing overturn dips in the direction of movement; the greater strength, however, of the solid crystalline gneiss in this particular case, offering more resistance than

the newer strata, would cause a break coinciding with the inclined plane at the junction of the gneiss and Quebec group; the strata of this group pushed up the slope would raise and fracture the strata of the formations above, and be ultimately forced into an overlap of that portion resting on the higher terrace, after probably thrusting over to an inverted dip that part of the upper beds with which they came in contact. The strata of the upper terrace, relieved from pressure by the break, would remain comparatively quiescent, and thus the limit of the more corrugated area would coincide with the slope between the deep and shallow water of the Potsdam period. But the resistance offered by the gneiss would not merely limit the main disturbances, it would probably also guide or modify in some degree the whole series of parallel corrugations, and thus act as one of the causes giving a direction to the Appalachian chain of mountains.

REVIEWS AND NOTICES OF BOOKS.

Life on the Earth, its Origin and Succession, by John Phillips A.M., LL.D., F.R.S., Late President of the Geological Survey and Professor of Geology in the University of Oxford.

This volume contains the substance of the Bede Lecture, delivered at Cambridge, in May 1860. Like everything that Prof. Phillips does, it is clear, accurate and scholarly. It gives in small compass and in a manner intelligible to all, a summary of the facts known to Geology respecting the introduction and order of succession of life on the earth, without any of the exaggeration and looseness of statement too common in popular books. It can be safely recommended to every one desirous of knowing the present state of this subject, and its bearing on the Darwinian doctrine of the origin of species by natural selection. The work might afford many interesting extracts, but we content ourselves with copying the Author's concluding reflections, which are full of great truths, and with recommending our readers to procure the work for themselves.

"These various speculations on the subject of Fossil plants and animals, and the origin and progress of life, may perhaps, to the student of exact science, appear little more than the chase of a phantom, a wandering after unattainable truth. There is, however, something seduc-

tive in the problem of the origin of life, and one who has entered on this charmed path, will seldom leave it without reluctance. Vain and ill-judged as are some of these attempts, they ought perhaps not to be visited with the heavy condemnation which sometimes has been heaped upon them. Men may have mistaken views about the diluvial catastrophe; false conceptions regarding electricity as the agent of imparting life; wrong notions about the nature of atoms, and yet not reason, at least intentionally, as 'atheists,' denying the incessant watchfulness of God over the arrangements which he has appointed. It is hard to believe this of any serious thinker, even of Lucretius, however strongly he may contend for the regular operation of natural laws, in opposition to the capricious meddling of those monstrous personifications of human passions, which were accepted for deity by the 'too superstitious' men of Athens and Rome. Erroneous opinions have but their day, and are, perhaps less mischievous, than the indolence which acquiesces in dull and incurious conformity with whatever may reign for the moment. Truth, or what appears such to human reason, operating on real facts and just inferences, this is the end of scientific research; while we seek it, let us not be too much troubled if some run in courses wide of our own, and ask questions we think not likely to be answered. If we do not ourselves believe the origin of created life to be discoverable by a creature limited to the observation of sensible phenomena, why should we restrain the enterprise of those who, vainly striving after something that is unattainable or fabulous, may yet win much that is accessible, valuable and real?

"According to most of the hypotheses we have been considering, the forms, structures and habits of life, which we now circumscribe by specific characters, however distinct these may seem to be, are only constant for this moment, slowly varying through this period, as they have varied in preceding periods, possibly then at a greater rate than now. The forms that now are have had a long series of progenitors, gradually changing from the earliest times; many of the earlier races of a great common stock having died out, while others came into view; the whole theatre of life always full of action, but the actors continually changing, however slow the process of change.

"But, as already observed, the evidence of most value for deciding the probability of such a progressive change in the forms of life is to be furnished by geology. That it does not furnish good evidence in favour of gradual and indefinite change is perhaps generally allowed; but that it does furnish evidence of interrupted and limited change, and that the changes mark steps of progress, is a prevalent opinion. It is the opinion of Mr. Darwin, that if the record of life in the fossiliferous strata were complete, those changes which now appear interrupted and sudden would be found to have been continuous, and the progress by steps would become an inclined plane of easy ascent. This incompleteness he assumes to be enormous; so much so that the traces of whole periods of immense duration, including the first period, are lost; what we possess being merely fragments of the record, which indeed never was

complete, owing to the character of some kinds of deposits. Thus we must not expect to be able to arrange the fossil remains in a real however broken series, since the true order and descent may be, and for the most part is irrecoverably lost.

" Surely this imperfection of the geological record is overrated. With the exceptions of the two great breaks at the close of the Palæozoic and Mesozoic periods, the series of strata is nearly if not quite complete, the series of life almost equally so. Not indeed in one small tract or in one section ; but on a comparison of different tracts and several sections. For example, the marine series of Devonian life cannot be found in the districts of Wales or Scotland, but must be collected in Devonshire, Bohemia, Russia, and America. When so gathered it fills very nearly if not entirely the whole interval between the Upper Silurian and the Carboniferous Fauna. So in England the marine intermediaries of the Oolitic and Cretaceous ages are not given : but the Neocomian Strata supply the want. We have no Meiocene Strata in England, but their place is marked in France and America.

" Even the great breaks alluded to are bridged. The Permian series of life contains some Mesozoic interpolations ; and the Lias contains reliquiæ of some Palæozoic genera. The upper chalk of Maestricht and the South of France extends toward the Tertiaries the reign of the Upper Mesozoic beds.

" On the whole, it appears that there exist ample materials for testing any hypothesis of the sequence of life which includes the marine races ; and that there is much ground for believing, in regard to the chasms which do exist in the series of freshwater and terrestrial races, that if filled, they would not lead to other inferences than such as appear consistent with the records of the sea. If the monuments of the earlier life of the globe are essential witnesses, but too few and independent for a satisfactory test of a given hypothesis of the sequence of life, it is unfortunately ineligible for admission among accepted truths.

" Caloric, electricity, chemical action, are all influential on life ; elevating and depressing it, carrying it on or bringing it to a close, according to the measure and mode of application of these powers of nature. Employed as they are in the current of life, and at every moment acting on and being acted on by it, nothing has seemed easier to speculation than to conceive these agencies so operating on appropriate matter as to *make* the vital machine which could not be kept in motion without them. The only thing wanted is the due co-ordination of these powers, in the appropriate matter. Here unfortunately is the difficulty—*due co-ordination* of independent powers in matter *rightly adapted* implies the directing mind of the Master of power and matter. The formula is imperfect—

We start, for LIFE is wanting there

" Given, however, the appropriate matter, and the stroke of life upon it, what have we—no living thing—but vitalized matter. Capable of what? Self-development? Into what simple organic form? The an-

swer seems to have been an Infusory Animalculum, before the scrutiny of the microscope had shewn the real complexity of most of these children of unknown fathers, the transition stages of others, the definite course of life of all. At present the first hopeful product of the cryptogamy of electricity and carburetted moisture would be a fertile cell, for cells are the ultimate term of the mechanical analysis of organic beings.

" Given then a cell with walls ; composed of carbon, hydrogen and oxygen ; capable of self-division and so of increasing in number. Let it be born in the sea according to Telliamed, or, in moisture, or slime, according to Lamarck, or if it suit better the following phenomena, in the air. What follows ? An aggregation of cells. Plant or animal ? Perhaps neither, but a living being, capable not of moving, but of being moved, says Lamarck, by the external powers influential on life, like Volvox. What next ? Reproduction of other Volvoces by self-division, or the growth of new individuals within the parent.

" Here the process, so far as our knowledge and observation go, at present, must stop—the aggregate of cells breaks up into smaller aggregates, or is resolved into solitary cells again, and our little circle of discovery is completed.

" Given, therefore, something more ; a current of water guided by cilia through the mass ; removal and renewal of cells ; addition of a new substance to line the canals, in forms determined by these currents ; the growth of germs capable of being separated and going through the same series of events ; in short a sponge, for the possession of which Botany and Zoology have had a long conflict, and which seems placed at the very lowest limit of specific life.

" What is the next step, or rather leap, is hard to say ; for if we go to the minute Foraminifera, that is a group of aggregated and perforated shells, with cilia, which helps us very little or not at all in the advancement of animalization ; but if we ascend *per saltum* to the Zoophyta most allied to Spongiadæ, and claim affinity with Alcyonium, we require the large postulates of freely moving polypi, with eight arms round the contractile mouth, a complete digestive cavity, and ova of definite character.

" Then again is another hiatus between the Alcyonidæ and the Mollusca, which neither fossil nor recent life can fill ; and thus in what seem to be the first and easiest steps we can imagine, nothing but postulate upon postulate will bring us on our way. But postulates in the sense here used are equivalent to special endowments, not in the least easier to conceive of than separate creations ; for what are these but endowments, and has not every special structure its appropriate germ and mode of growth ?

" If it is not possible in the existing ocean, among the innumerable and variable radiated, amorphozoan, and foraminiferous animals, to construct one chain of easily graduated life, from the fertile cell to the prolific ovarium and digestive stomach, it must be quite in vain to look for such evidence in the fossil state. In the face of the assumptions requisite to imagine such a chain, we cannot venture to adopt it as a

probable hypothesis, and thus the idea of one general oceanic germ of life, whether we like it or not, must be abandoned. Reasoning of the same kind will convince us that to derive by any probable steps any one great division of the animal kingdom from another, involves too much of a hazardous assumption to be adopted by a prudent inquirer.

"Take, therefore, the hypothesis in an easier shape, and accept as primary structures in general forms all the great invertebral divisions which reside in water; let us suppose them capable of indefinite variation, and inquire what is the geological evidence in proof of each later group being derived from some earlier one by descent with modification. Take the least incomplete series of forms, viz. the Mollusca, and undoubtedly the most favourable of all the marine groups for the application of hypothesis.

"The earliest known Mollusk is the Brachiopod Lingula; which, as already observed, recurs in all the systems of strata, and is still living. It gives no generic branches. The next earliest are the Dimyarian genera, Ctenodonta and Cucullella, which cannot be regarded as descended from any conceivable Brachiopod, or accepted as progenitors of Modiola, Orthonota, Cardiola or Pleurorhynchus; still less of their Monomyarian companions, Ambonychia, Avicula and Pterinea. It is inconceivable that from these or anything like them could be derived the Gasteropod, Euomphali, Loxonemæ, &c., or that the Heteropod Bellerophon, the Pteropod Theca, or the Cephalopod Orthoceras, are consanguineous, any one of them with any other. All these grea classes then are *according to the evidence* equally aboriginal, though no of equal antiquity.

"Without bringing in similar results from the other invertebral classes we may boldly affirm that the later series of Cambro-Silurian life cannot possibly be derived from the earlier series, according to the evidence preserved to us; but on the contrary requires absolutely the admission of separate stemmata, certainly for every principal group, apparently and probably so for every genus or natural assemblage of much resembling forms with similar structures.

"The explanation offered by most palæontologists is that these several stemmata are of independent origin, separate creations in fact, using this term to indicate a process unknown to us, by which the Creator has provided for the appearance of new forms and structures at definite times and in certain places, which it is in the province of palæontology to search out. The explanation offered in the hypothesis of Mr. Darwin, is that the groups of life which appear to be and really are distinct, in the Cambro-Silurian rocks, are not aboriginal forms; but derived from progenitors of far earlier date, belonging to few types or to one; the original form, and the transition forms being unknown to us.

"Now they are not unknown to us by any impossibility of being preserved, for the strata of the Cambro-Silurian series are of a kind in which organic remains of great delicacy are often preserved, and indeed such are preserved in these very strata; and by the hypothesis the life-structures which are lost must have only gradually differed in their

nature from those which are preserved. It follows, therefore, that the earlier living progenitors of the Cambro-Silurian series, not only lived long before but must have lived somewhere else. But as in all the known examples of this series of strata, wherever found, we have everywhere animals of the same general type, and nowhere the traces of earlier progenitors, it is clear that everywhere we are required by the hypothesis to look somewhere else; which may fairly be interpreted to signify, that the hypothesis everywhere fails in the first and most important step. How is it conceivable that the second stage should be everywhere preserved, but the first nowhere?

" This difficulty occurs again and again, not only at the great breaks of the series of strata accompanied with much disturbance and change of sea-bed, but during the ordinary and least interrupted accumulations of deposit, for example, in the Silurian and Oolitic systems, in each of which new families and genera, new types of structure in short, make their appearance frequently at definite stages, and always compel the hypothesis to the same answer—look elsewhere for the progenitor—the father is never buried with his children.

" Is there not at the base of all these hypotheses of one continuously branching stream of variable life, some trace of the common errors of assuming that to be true without limits, which is acknowledged to be true in a restricted sense; of employing infinite time to integrate quantities which are subject to no law of varying magnitude; and of assigning a resultant to unknown and inconstant directions? Do we not find the 'mutability of species' illustrated by examples of *limited* change, effected by the *directing* agency of man; and then what stands for an inference that *unlimited* changes have been effected or are in progress by the *undirected* combination of external conditions? Are we sure that varieties which are given by nature in successive generations, can be *summed in one direction* by the variable preponderant of a number of *concomitant variable* conditions of life? Can we remove 'natural selection' from the large synonymy of 'chance,' except by giving to one of the variable conditions of which it is the sum, direction, definite value or effect? Is it not the one acknowledged possession by every species of an inherent tendency to propagate its like? Would not the effect of this one constant among any number of variables without law, be to preserve the characters of the species for ever? And if 'natural selection' were regarded as giving direction to these variables, in combination with that constant tendency, what would be the final result but that which has always been recognized, viz. a species varying within limits which are to be sought out by experience? But, finally, if Natural Selection be thus gifted with the power of continually acting for the good of its subject—encouraging it, or rather compelling it to continued advancement,—

Αἰὲν ἀριστεύειν καὶ ὑπείροχον ἔμμεναι ἄλλων,

how is this beneficent personification to be separated from an ever watchful providence; which once brought in to view sheds a new light over the whole picture of causes and effects?

"It may be thought that, while professing to keep to the old and safe method of reasoning on known causes and ascertained effects, we deviate from this principle in regard to the origin of life, and introduce an unknown cause for phenomena not understood, by calling to our aid an act of 'creation.' Be it so, let the word stand for a confession of our ignorance of the way in which the governing mind has in this case acted upon matter; we are equally ignorant in every other instance which brings us face to face with the idea of forces not manifested in acts. We see the stream of life flowing onward in a determined course, in harmony with the recognized forces of nature, and yielding a great amount of enjoyment, and a wonderful diversity of beautiful and instructive phenomena, in which MIND speaks to mind. Life through many long periods has been manifested in a countless host of varying structures, all circumscribed by one general plan, each appointed to a definite place, and limited to an appointed duration. On the whole the earth has been thus more and more covered by the associated life of plants and animals, filling all habitable space with beings capable of enjoying their own existence or ministering to the enjoyment of others; till finally after long preparation, a being was created capable of the wonderful power of measuring and weighing all the world of matter and space which surrounds him, of treasuring up the past history of all the forms of life, and of considering his own relation to the whole. When he surveys this vast and co-ordinated system, and inquires into its history and origin, can he be at a loss to decide whether it be a work of Divine thought and wisdom, or the fortunate offspring of a few atoms of matter, warmed by the *anima mundi*, a spark of electricity, or an accidental ray of sunshine."

An Introduction to the study of Gothic Architecture. By JOHN HENRY PARKER, F.S.A., &c. 2nd edition revised and enlarged. Oxford and London: J. H. & J. Parker. Montreal: B. Dawson & Son.

The new edition of this excellent manual has been carefully revised by the author, with considerable additions. The book is one of facts and not of fancies and theories. It states only what is well known, and has been established by painstaking research. It was originally written as part of a series of Elementary Lectures delivered to the junior members of the Oxford Architectural Society. The illustrations which it contains are remarkably good, and may be understood by any one. In this country where architecture is just beginning to attract attention, this book will prove useful to amateurs in the way of forming their tastes, and directing them in matters of beauty and utility. It may be questioned whether the Gothic or any of its accepted forms is just

the style of architecture best adapted for the climate of this Province, still, having so many points of excellence to commend it, especially for ecclesiastical buildings, it may be hoped that skilful adaptations of its peculiar forms may be devised to render it suitable for our use. We heartily commend this interesting and beautiful little book to the attention of our readers.

A course of six Lectures on the Chemical History of a Candle, to which is added a Lecture on Platinum. By M. FARADAY, D.C.L., F.R.S., &c. Delivered before a Juvenile Auditory at the Royal Institution of Great Britain, London, with numerous illustrations. Edited by William Crookes, F.C.S. London: Griffin, Bohn & Co. Montreal: B. Dawson & Son.

This is another of these admirable little books by Professor Faraday, in which in the simplest and most beautiful language he aims at instructing young persons in some of the interesting phenomena of the material world. The subject seems commonplace, and yet it possesses an abundant interest, and affords varieties of outlets into the various departments of philosophy. There is not a law under which any part of the universe is governed which does not come into play, and is not touched upon in these phenomena. The learned Professor treats in the most graphic way of the various kinds of candles which are used for the purposes of light, and of the chemical action which they manifest. Light, heat, water, air, and their elements are all explained and beautifully illustrated. This little book is worth its weight in gold. It brings profound knowledge and most extensive research down to the understandings of the young. Its simplicity never genders into childishness, as too many books for children do, but it is withal manly and vigorous. Old and young may read this book with interest and profit.

Bush wanderings of a Naturalist; or notes of the field sports and Fauna of Australia Felix. By an old Bushman. London: Routledge, Warne & Routledge. Montreal: B. Dawson & Son.

The author of this little book went out to Australia at the height of the gold fever, but finding himself unsuited by previous habits for the labour of gold digging, betook himself to the bush,

and along with another, sought an independent livelihood by hunting the game of the country. The kangaroo and the wild dog are the only large animals of the chase in that country. The hunter's life is therefore not put to hazard by wild and ferocious animals. But for small game Australia cannot be surpassed. The duck, pigeon, quail, and snipe, may be killed in almost any quantities, at the proper season, in those districts where they have not been shot out. The book contains many acute and interesting observations as to the habits of these animals, and is a valuable addition to our knowledge of the fauna of that region of the world. The narratives are written in a lively and pleasing style, and the incidents although not of a thrilling or wonderful kind, are yet both curious and interesting. To the lover of natural history we recommend this contribution of fresh and trustworthy materials, for the illustration of his favourite study.

The Metals in Canada, a Manual for Explorers. By WILLSON & ROBB.

This little book might with great advantage be in the hands of all our numerous explorers and "prospecters" for metallic deposits. It gives in the first chapter a succinct view of the usual modes of occurrence of all the more important metallic ores. It next treats of the proper mode of exploring for them; after which it takes up several of the metals, as gold, silver, copper, lead, &c., in detail, and with special reference to the localities in which they occur in Canada. The last chapter contains a summary of the more useful tests for the principal metals.

The authors acknowledge their obligation to the Reports of the Geological Survey for the facts which they state as to local geology and mineralogy, and announce themselves as established in the capacity of mining engineers in Montreal.

Remarks on the Final Causes of the Sexuality of Plants, with particular Reference to Mr. Darwin's Work 'On the Origin of Species.' By Charles Daubeny, M.D. (J. H. & Jas. Parker.)

Although put forth in a mere pamphlet, it is well that the Professor of Botany in the University of Oxford should record his opinion of Mr. Darwin's theory, regarded from its botanical side. Estimating the discovery of the sexuality of plants as the greatest step which has ever been made toward obtaining an in-

sight into the secrets of the vegetable organization—a principle which has of late been almost elevated to the rank of a demonstrated truth by minute observations,—he proceeds to say that—

"Those who believe with the Author (Mr. Darwin), that all animals, as well as plants, have sprung from not more than four or five progenitors, will trace in the sexual system the cause of the existence of all but the lowest forms of life; not indeed in the sense in which the vulgar understand it, as if no fresh individual of a species could have been called into existence by any other and simpler agency, but because no deviation from the primeval type, and therefore no progress towards a more improved form, could otherwise have taken place, except indeed in a few exceptional cases, under the influences of different external conditions. For my own part, I am unwilling to be set down as yielding an entire and unqualified assent to this doctrine, when pushed to its extreme consequences; for although I must leave it to Naturalists more equal to the task than myself, to enter the lists against an antagonist furnished with so vast an armoury of facts, and gifted with so singular a power of applying them to the purposes of his theory, I must demur at considering the distinctive faculties of the beings that stand in the higher ranks of the creation as mere developments of those which exist in the lower. I can hardly bring myself to believe, that the activity, the quick perceptions, the various instincts, which we observe in the vertebrate, can have been elaborated out of the dull vegetative faculties of the invertebral class; and still less that the reason, the imagination, the moral sense of man, can have been owing to a mere expansion of the brain of the Gorilla."

Towards the conclusion, Dr. Daubeny adduces a counter-argument to the proposed theory which, though employed by some naturalists in the controversy, has not been perhaps as yet sufficiently estimated. The foundation of Mr. Darwin's reasonings is the achievements of human skill in the domestication of animals, and the facts connected with domestication are those to which he constantly refers with confidence in support of his theory. "All the rest, however appropriate to the development of his argument, however well calculated to remove objections, or to impart a degree of probability to his speculations, seem either to lie beyond the range of actual experience, or to lend him only that indirect support which may be afforded by their accordance with the hypothesis, once assumed to be true....But," continues Dr. Dau-

beny, "although human ingenuity has doubtless introduced many very striking deviations, both in plants and animals, from the original type, it has never yet, I believe, proceeded so far as to give rise to what naturalists would regard as a new species, that is, an individual incapable of producing a fertile progeny with any other member of the parent stock."

In connection with this pamphlet, may be read the summary of the arguments of Prof. Asa Gray, which we presented in *Athen.* No. 1710. Thus the reader will have the calm pleadings of two distinguished botanists for and against the ingenious Theorist now taking his trial in the Court of Natural Science. Both botanists however, agree that Variation and Natural Selection are " probably inadequate to the work which they have been put to."—*Athenæum.*

The Canadian Naturalist. A series of conversations on the Natural History of Lower Canada." By P. H. Gosse, London, 1840.

The intelligent author was fully aware when he published the above work, that confusion arose from want of a thorough knowledge of entomological nomenclature. The book has a good circulation in the Provinces, and is accessible to young students of entomology. To my knowledge the tyro has frequently made confidential reference to it for the purpose of naming his insects. I have therefore reviewed the whole of the entomological index, commencing with the

COLEOPTERA.

Brachynotus Bennettii, (page 78), should be *Podabrus tricostatus*, Say.

Rhizotroga fervens, (p. 106), should be *Phyllophaga quercina*, Knoch.

Phyllodecta vittelina, (p. 185), should be *Gastrophysa vitellinæ*, Linn.

Meloe proscarabæus, (p. 185), should be *Meloe angusticollis*, Say.

Chrysomela 10-notata, (p. 185), should be *Calligrapha Philadelphica*, Linn.

Odontqmis trinervia, (p. 224), should be *Chrysobothris dentipes*, Germ.

Nephropis Canadensis, (p. 224), should be *Leptura Canadensis*, Oliver.

Lyctus reticulatus, (p. 230), should be *Diagrapha reticulata*, Fabr., and *Lyctus terminalis*, (p. 231), should also be placed under the genus *Diagrapha*.

Stenuris divaricata, (p. 232), should be *Stenurus* (*Dicerca*) *divaricata*, Say.

Anoplis rusticorum (p. 232), should be *Buprestis rusticorum*, Kirby.

Platycerus placidus (p. 272), should be *Parandra brunnea*, Fabr. *Placidus*, Say, belongs to the genus *Lucanus*.

Gymnodus rugosus (p. 272), should be *Osmoderma scabra*, Beauv., and on the page following *Gymnodus Drakii*, which is *Osmoderma eremicola*, Knoch.

Pathophagus latibrosus (p. 320), should be *Onthophagus Hecate*, Pz.

Boletophagus cristatus, (p. 251), should be *Boletophagus cornutus*, Pz.

Eumolpus Bigsbyana, (p. 122), should be *Calligrapha Bigsbyana*, Kirby.

Cucujus rufus, (p. 122), should be *Catogenus rufus*, Fabr.

Ips. quadripunctata, (p. 122), should be *Ips. 4-signatus*, Say.

Thanatophilus marginalis, (p. 136), should be *Oiceoptoma marginata*, Fabr.

Lampyris corrusca, (p. 296), should be *Ellychnia corrusca*, Linn.

Elater metallicus, (p. 185), I know of no Elater ("changeable crimson and green") of this name, *Limonius metallescens*, Mels. is a var. of *L. plebejus*, Say, which if occurring in the North, may be the insect mentioned by Gosse.

Carabus catena, (p. 185). There is no Carabus of this name in the Coleopterous fauna of the North. The one alluded to is evidently *Carabus Canadensis*, Leconte.

Staphylinus chrysocephalus, (p. 319). There is no Staphylinus of this name in the catalogue. It is either a nondescript or var. of *S. cingulatus*, Grv. I have seen but one specimen which was taken at Toronto, by F. H. Ibbetson, Esq., who identified it as distinct from *cingulatus*.

LEPIDOPTERA.

Thymele briso (p. 184), belong to the genus *Nisoniades*, Hübn.

Melitæa myrina (p. 192), belongs to the genus *Argynnis*, Fabr.

Hesperia Peckius (p. 193), should be *Pamphila Peckii.*

Platypteryx erosa (p. 194). No geometra of this name occurs in North America. The moth noticed by Gosse is probably *Poaphila erosa*, Guén.

Angerona sopeta (p. 194), is a wrong citation. The genus Angerona of North America has but one described species. *Chlorissa putatoria* does not occur in Canada. Mr. Gosse has evidently applied European names to the greater part of the moths mentioned in his work. *Geo. clematoria* cannot be found in the Northern Insect fauna. The species of Phragmatobia (p. 195), which Mr. Gosse took to be the European *fuliginosa*, I take to be *P. assimilans*, and the only described North American species.

Smerinthus occelatus, (p. 222), should be *S. geminatus*, Say.

Pamphila cernes (p. 228), should be *P. origenes*, Fabr.

Hipparchia andromacha (p. 246), should be *Debis Portlandia*, Fabr.

William Couper, Quebec.

The Canadian Journal, No. 33 *; Drift Deposits of Western Canada.*

On this interesting subject, to which Mr. Bell directed attention in a late number of the *Naturalist*, Prof. Chapman communicates some valuable notes to the *Canadian Journal*, Toronto. The deposits may be divided into a lower and upper member. The former consists of dark blue and greyish clays in some places with yellowish bands, and is destitute of boulders or nearly so. This deposit much resembles our Leda clay of Lower Canada, but no marine fossils have been found in it. The upper member consists of sand and gravel, with numerous boulders. When these rest on the rock without the intervention of the lower member the former is always striated and polished; and this effect has been observed up to a height of 1500 feet. Prof. Chapman mentions several additional localities of fresh water shells in these deposits, beside those referred to by Mr. Bell; and thus sums up the mammalian remains which they contain:—

" In some of these re-sorted beds, the bones and teeth of both extinct and existing mammals are occasionally found. The extinct forms comprise: a species of Mastodon (*M. Ohioticus?* see *Can. Jour.* New Series, vol. iii. p. 356); the *Elephas primige-*

nius; and apparently an extinct species of the horse. The remains of existing species found in these deposits (always confining our remarks to Western Canada), include the Wapiti, the Moose, Beaver, Muskrat, &c. These two classes of remains have been found together. In a railway cutting through Burlington Heights, near Hamilton, the tusk of a Mammoth (*Elephas primigenius*) and the horns of a Wapiti (*Elaphus Canadensis*) were met with at a depth of about forty feet below the present surface of the ground.* I have also seen the lower jaw of a Beaver (*Castor fiber*), obtained from the same locality. The flint arrow-heads, and other wrought implements of Amiens and Abbeville, which are now attracting so much attention in Europe, occur, apparently, in deposits of the same kind and age."

With respect to the conditions of deposition of these beds Prof. Chapman presents the following general views :—

1. "A general depression of the land, at the commencement of the Drift period, must have taken place to such an extent as to admit of the deposition of the lower clays. These latter were evidently derived from the limestones and other Silurian and Devonian strata lying beneath and around them. Hence their generally calcareous nature. Their derivation from this source is proved, moreover, by the pebbles of Trenton limestone and other fossiliferous rocks which they frequently contain. Extensive denudation must thus have occurred both immediately prior to, and during, the deposition of these clays; but it may be questioned whether the bolder contours offered by the denuded rocks, such as the escarpment that sweeps from the Niagara river to Cabot's Head on Lake Huron, were not produced during the first uprise of the palæozoic strata from the earlier seas in which their materials were accumulated, ages before the period now under discussion. It appears, at least, to be a well-admitted point, that these rocks had been elevated into dry land before the deposition of the higher formations in the south and west.

2. "After the deposition of the lower Drift clays, a sudden and abrupt change in the character of the sediments took place. A striking example of this may be seen in the natural sections about Hogg's Hollow, a few miles north of Toronto. The change in question must have been effected by a still further depression of the country, bringing the higher lands and gneissoid strata of

* See a paper on the Geology of this district, by Charles Robb, C.E., in Canad. Journal, New Series, Vol. v. p. 510.

the north within the influence of the waves, and yielding the sands, gravels, and boulders of the upper Drift accumulations. This depression permitted an invasion and broad extension southwards of the ice-covered Arctic seas, the true cause, in all probability, of the cold of this epoch. The depression must have exceeded 1,500 feet, since northern boulders are found at that height above the sea, on the Collingwood escarpment. The gneissoid boulders there met with, must at least have traversed the basin of Georgian Bay; but the glacial striæ which also occur there, may have been produced by the action of ice, originating at the spot itself. The three or four distinct sets of striæ observed at this locality, however, do not radiate from any fixed point, but run in the usual north and south direction, some being a little east and others a little west of north.*

3. "At the close of this second series of phenomena, a gradual uprise of the land appears to have taken place, and a vast area, extending over and around our present lake basins, then became converted into a fresh-water sea. This probably found its outlet to the ocean through what is now the broad valley of the Mississippi. Its waters stood at a great elevation above the waters of our present lakes, and were gradually lowered to these levels by physical changes in the surrounding country, and more especially by the depression of a higher region lying to the east. During this gradual fall and retrocession of the great lake waters, the upper layers of the Drift were re-sorted, mixed with newer sediments, and thrown up here and there into secondary ridges; and the remarkable terraces which form so salient a feature in the general aspect of our lake shores and intervening districts, were then in chief part produced. The escarped faces of these Drift terraces, it should be observed, *always front the present lake-basins*, and thus look in some places towards the north, and in others towards the south, &c., according to the direction of the nearest shores. This would necessarily arise if they were produced, as here imagined, by a gradual lowering of the waters, with intervening periods of repose. The shells of fresh-water mollusca, buried in the modified Drift, at various levels above the existing lake-waters, and in localities so far apart—for these shells have been found throughout the region south of the lakes,

* On a visit to this spot, since the publication of the "Note on the Geology of the Blue Mountain Escarpment," in the *Canadian Journal*, Vol. v. p. 304, some additional sets of striæ were observed.

in addition to the localities mentioned in this paper—prove incontestibly the former expansion and union of our lakes, or, in other words, the presence in this part of Western America, of a widely extended fresh-water sea, covering an enormous area. A curious circumstance, and one of great significance in its bearings on this question, is the fact that all the inclined layers of modified Drift (to the east, at least, of Lake Superior) appear to slope towards the west or south. A remarkable instance of this, hitherto, it is believed, unnoticed, may be seen near the mouth of the Niagara river, at Lewiston. At this spot, oblique layers of modified Drift, in beds made up of coarse gravel and pebbles, point nearly due south, and thus bear witness to the fact, that the current, which occasioned the inclined stratification, must have set directly up the gorge, *or against the direction of the present stream.*

"The assumption of an immense fresh-water lake of this character, gradually falling from a high level, necessarily involves the additional assumption of an eastern barrier, extending at one period between the lake-waters and the Atlantic. This view was maintained by some of the earlier investigators of our geology, and, notably, by Mr. Roy, in his much-discussed paper on the terraces of Lake Ontario, communicated to the Geological Society of London, in 1837.* The difficulty of finding a satisfactory location for a barrier of this kind, led Sir Charles Lyell, however, to reject the idea of an original lake extension, and to refer the formation of our terraces entirely to the action of the sea, during the slow uprise of the land at the commencement of the present epoch. In this, he has been followed by all Geologists who have subsequently examined these terraces. The difficulty may perhaps be surmounted, by assuming the earlier and greater elevation of that portion of the country lying to the east of the gneissoid belt which connects our northern Laurentian district with the Adirondack Mountains of New York. The subsequent depression of this region would open an eastern outlet to the lake-waters, and gradually lower these to their present levels. But whatever the explanation, the undoubted fact remains, that,

* See likewise the paper already referred to, by Sanford Fleming, C.E., on the physical characters of the Nottawasaga Valley.—*Can. Journ.* First Series, Vol. i. Mr. Roy's paper, I believe, was never printed.

at the close of the Drift period, a vast fresh-water sea extended over the greater portion of Western Canada, and at a level of at least 500 feet above the present surface of Lake Ontario."

Prof. Chapman does not enter into the question of the relative age of the Drift deposits of Upper Canada, as compared with the marine Pleistocene beds of Lower Canada described in this Journal by Mr. Billings, Dr. Dawson, and Mr. Bell. Our present belief is that the upper member described by Prof. Chapman must correspond with the Saxicava sand and the lower member with the Leda clay. Dr. Dawson has shown* that at Pakenham on the Ottawa, and also toward Lake Champlain, the Saxicava sand, or its equivalent, is rich in fresh-water shells, while it contains very few that are marine, and these principally *Tellina groenlandica.* Mr. Bell has in his late paper largely added to facts of this class. On the other hand, such cases have not occurred in the eastern part of Lower Canada. This points, as Mr. Bell infers, to a passage into estuarine and fresh water conditions toward Upper Canada, and we need not be surprised that these actually occur there. The Saxicava sand also, like the upper deposit in Upper Canada, often contains Laurentian stones and boulders. With respect to the equivalency of the Leda clay to the lower member of Prof. Chapman's series, we may remark that the mineral character of the two deposits corresponds. Further, the Leda clay holds few boulders and except in its upper part very few fossils. Indeed many parts of it are quite destitute of these, especially where the upper layer has been removed by denudation before the deposition of the sand or gravel. This may possibly be its general condition in Upper Canada.

Should these views prove correct, it will not be necessary to suppose that the enormous lakes indicated by the fresh water deposits of Upper Canada emptied themselves into the Mississippi; since the character of the Saxicava sand in its upper parts implies the influx of much fresh water from the west. Still the occurrence of marine shells in Lower Canada at heights of more than 400 feet above the sea, points to entire submergence of the country around Lake Ontario; and it may well be that the ancient extension of the lake was only one of the phases of the process of elevation in the period indicated by our Saxicava sand. It still requires however the discovery of marine shells in the

* Canad. Nat. Vol. iv. p. 16, Vol. v. p. 194.

lower part of the Upper Canada Drift to remove from the relations of these deposits in Upper and Lower Canada, all that ambiguity which has so often been referred to in papers in this Journal. In the mean time, we hail the labours of Prof. Chapman and Mr. Bell as important contributions towards this end, and as already pointing out a probable solution of the difficulty.

J. W. D.

MISCELLANEOUS.

A few Notes on Analysis by the aid of the Spectrum.

As colour is so conspicuous a characteristic of many substances, it is not surprising that the chemist largely avails himself of its indications in qualitative analysis. These indications are, however, neither so reliable nor so extensively useful in chemical determinations as might at first sight appear; for in the first place, the colours of many substances vary very much, according to their state of aggregation, and to other circumstances not affecting their chemical constitution,—in the second place, the colour of a compound does not appear to be a resultant of the colours of its elements,—and lastly, the unassisted eye is unable to distinguish hues differing but slightly, unless opportunity for comparison with each other be afforded; or, in case of compound tints, to determine the tints compounded, as for instance, whether an olive green result from an intermixture of violet and yellow, or of orange and blue.

Any inaccuracy arising from imperfection of the eye, can however be almost, if not altogether, eliminated by prismatic decomposition of the light reflected from, or transmitted through the coloured substance; and by comparing the spectrum thus produced with the solar spectrum, the most precise information can be obtained respecting the tint under examination. Thus, to recur to the illustration adduced above, the different refrangibilities of the component colours would enable us readily to distinguish the one olive green from the other. Undoubtedly the best mode of thus examining the colour of a substance, which is either a liquid or capable of solution in a liquid, is that employed by Dr. Gladstone in his late researches on the absorption of light by coloured media. In his experiments, a wide, thin beam of light was transmitted through a long, narrow, and gradually tapering hollow

wedge of glass, filled with the liquid under examination; so that while one edge of the sheet of light passed through an indefinitely thin stratum of liquid, the other edge passing through the thick extremity of the wedge, traversed a stratum of about three-fourths of an inch thick. The light thus transmitted was decomposed by a prism held parallel to the width of the sheet of light. Thus a broad spectrum was thrown up for examination. That portion of the spectrum adjacent to the thin edge of the wedge, and formed by light which had traversed it, differed of course but little from the solar spectrum; but it was not found as might perhaps be supposed, that the brilliancy of the colour of the spectrum uniformly diminished towards the thick end of the wedge. On the contrary, some hues were found (with most media) to diminish much more rapidly, and be extinguished much sooner than others; so that while the one side of the broad spectrum, that towards the thin edge of the medium was terminated by a straight line, the other side was bounded by a deeply indented sinuous outline, certain bands of colour extending much further towards the thick end of the wedge than others. For example, when a solution of sesquichloride of chromium was the medium, the violet, indigo, and yellow rays were almost immediately extinguished, leaving a broad projection of blue and green, and a narrower, but much longer, arm of red. Thus is explained the fact that dilute solutions of this salt appear green, and concentrated solutions purple. In this manner relations of colour between combinations containing a common element were discovered, which the unaided eye could not have detected. More than this, unfailing means of determining the presence of certain elementary substances were pointed out; thus didymium invariably announces its presence in solution, even when in small quantity, by two very black lines, one in the yellow and one in the green.

Interesting as these results are, and important as they may become, the somewhat similar investigations pursued still more recently by Kirchoff and Bunsen, are of surpassing interest and importance.

The distinctive hues imparted to flame by certain substances have long served to indicate their presence in blow-pipe analyses. It has been further observed, that different substances impart distinctive appearances to the electric flame, appearances especially remarkable when analyzed by the prism. It has been reserved, however, for the philosophers above named, to examine

elaborately these peculiarities of bodies, and accurately to distinguish from one another by this means certain bodies susceptible of such examination. They have showed that when a portion of one of the metals of the alkalies or alkaline earths, or indeed of almost any chemical element, is introduced into a flame, a beam of light from which passes through a prism and forms a spectrum, its presence in the flame is signalized by the simultaneous appearance of one or more vivid lines of light in the spectrum. Thus sodium or any of its salts in any flame, gives two adjacent lines of bright orange, while lithium gives a brilliant red line. They have further demonstrated, that these characteristic lines are constant in position, notwithstanding very great variations in the intensity of the flame, and independently of the form of combination in which these substances may be supplied. Still further they have established the statement that when any of these metals are placed upon a fine platinum wire enclosed with a similar wire in a glass tube, sparks from a Ruhmkorff's induction apparatus being made to pass from wire to wire, the spectrum of the light so generated, is identical with that of the flame into which these substances are introduced.

Analytical processes founded on this principle prove to be of unapproachable delicacy and precision. When a small portion of a powder to be analyzed is projected into a flame, or better still, is enclosed in the little apparatus above referred to, the presence of considerably less than one hundred thousandth part of a grain of sodium, or potassium, or lithium, can be detected with certainty by the practised observer. Already have investigations of this nature brought to view at least two new metals; one, cæsium belonging to the calcium group of metals, and one, yet unnamed, belonging to the sulphur group of elements. The former, discovered by the originators of this mode of investigation, announced itself by two blue lines, one especially bright being towards the violet end of the spectrum. The latter, found associated with selenium and tellurium, by Crookes, signalized its presence by a remarkable and unmistakable bright green line, leading to its identification as a hitherto unknown element.

The same investigators show that a flame giving any bright line in the spectrum, while transparent to other light, is opaque to that particular ray. Hence a kind of negative spectrum of a flame may be produced in which the bright lines are replaced by dark ones, by placing behind it a much more brilliant light giving a continuous spectrum. Thus magnesium gives when present in

an alcohol flame a spectrum having three intense green lines very near together. Let now the alcohol flame be illuminated by the incomparably more vivid oxy-calcium light, and the spectrum before feeble is greatly enhanced in brilliancy, all the light from the latter source, except that corresponding to the three green lines, freely penetrating the flame. It follows that though these green lines are absolutely illuminated as much as at first, yet being relatively illuminated much less they appear as three lines of shadow across the spectrum. It will be apprehended that what has here for distinctness' sake been said of the magnesium spectrum and of three lines in it only, applies equally well to all spectra with all their luminous lines. Here then as Kirchoff intimates, is the explanation of the apparent paradox that while light from all artificial sources is characterized by bright lines, the solar spectrum, as first pointed out by Wollaston and Fraunhofer, is marked by numerous dark lines. It is in fact a negative spectrum. In the words of that author; "the sun possesses an incandescent gaseous atmosphere which surrounds a solid nucleus having a still higher temperature. If we could see the spectrum of the solar atmosphere, we should see in it the bright bands characteristic of the metals contained in the atmosphere. The more intense luminosity of the sun's solid body, however, does not permit the spectrum of its atmosphere to appear; it reverses it; so that instead of the bright lines which the spectrum of the atmosphere by itself would shew dark lines are produced." With these facts in view we are prepared to learn that the attempt has been made, not wholly unsuccessful, though yet incomplete, to analyze the solar atmosphere. The mode of procedure is intelligible enough. Two spectra in close proximity—the one, that of the sun—the other, that of any metal in the electric spark—are viewed simultaneously in the same telescope. If all the bright lines of the latter correspond exactly to certain of the dark lines in the former, it seems a warrantable conclusion that that metal is present in the incandescent solar atmosphere. If this exact correspondence is wanting it may be similarly affirmed that that metal is present, if present at all, in comparatively minute quantities. On such grounds Kirchoff asserts that the solar atmosphere certainly contains Iron, Chromium, Nickel and Magnesium, while if Silver, Copper, Zinc, Aluminum, Cobalt and Antimony are present they are in such small relative proportion as to fail to give any evidence of their presence in the spectrum.

S. P. R.

CHEMICAL SCIENTIFIC INTELLIGENCE.

Schonbein has advanced the opinion that oxygen exists in three states ;—

1st. As ordinary, comparatively inactive, or neutral oxygen ; 2nd. as ozone, negative oxygen,—O ; and 3rd. as what he has termed antozone, positive oxygen,+O ; and further that from the mutual action of the two last mentioned modifications of oxygen ordinary oxygen proceeds. He supposes that oxygen exists in the form of ozone in the oxides of silver and gold, and in several of the peroxides, as manganese, lead, &c., as well as in some other oxygen compounds; but that it is antozone which unites with protoxides of hydrogen, barium, &c., to form their peroxides. Thus he explains the facts that ozone eliminates inactive oxygen from peroxide of hydrogen, and that oxide of silver and peroxide of hydrogen decompose each other upon contact, suggesting that double decomposition takes place in either case according to the equations.

$$\left\{ HO, (+O) \right\} + (-O) = HO + (+O - O) = HO + O$$

$$\left\{ HO, (+O) \right\} + \left\{ Ag\ (-O) \right\} = HO + Ag + (+O - O) = HO + Ag + O$$

One objection to this hypothesis hitherto has been that antozone is as yet merely hypothetical. But Schonbein now announces that he has isolated this form of oxygen by acting upon peroxide of barium with monohydrated sulphuric acid, a gas being liberated which smells like ozone and turns the ozone test-paper blue, but which differs from that substance by its power of forming with water peroxide of hydrogen. He also announces that large quantities of this gas, about $\frac{1}{5000}$th, exist ready formed in a dark blue species of fluor spar found at Wulsendorf and long distinguished by its disagreeable smell. When this substance is triturated under water large quantities of peroxide of hydrogen are immediately formed. In further support of his view he affirms that whenever in the slow oxidation of phosphorous ozone appears, corresponding amounts of peroxide of hydrogen are simultaneously formed ; and that other slowly oxidizing substances, as zinc, have the same power of decomposing, so to say, oxygen into ozone and antozone. His views are worthy of attentive consideration, not merely because a class of reactions otherwise inexplicable is explained, but because of their accordance with certain views respecting the nature of elementary molecules rendered ne-

cessary by he theory of types in chemistry and by the dynamical theory of heat.

Deville and Debray recommend for the economical production of oxygen the calcination of sulphate of zinc, which at a heat less than that required to decompose binoxide of manganese breaks up into a light white oxide suitable for painting, sulphurous acid, and oxygen. As another and even preferable process they recommend the decomposition of sulphuric acid, by allowing a thin stream to traverse a vessel containing platinum sponge and heated to low redness. Oxygen and sulphurous acid are the results. The methods of removing the latter are obvious.

M. Carré freezes water by the cold produced by evaporation of liquid ammonia. His apparatus consists of two iron cylinders, the one three times the magnitude of the other, connected air tight by a tube. The larger vessel filled with a strong solution of ammonia is heated to about 140°. The smaller vessel is at the same time immersed in cold water. The ammonia expelled by heat from the larger liquefies in the smaller cylinder. On removing and cooling the larger vessel the ammonia is reabsorbed by the water so rapidly as to reduce the temperature of the other portion of the apparatus to the freezing point of mercury.

Kopp sums up the results of his investigations respecting the relation between composition and boiling point. They are briefly these. An alcohol $Cn\ Hn_{+2}\ O_2$ boils at a temperature of $(40+9.5n)\ ^0$Cent., the corresponding acid $Cn\ Hn\ O_4$ at 40° higher, and the isomeric compound ether at 82° higher still. The related alcohols, acids and ethers $Cn\ Hm\ O_2$, $Cn\ Hm\ O_4$ and $Cn\ Hm\ O_4$ boil at temperatures easily calculated by adding or subtracting 5° for every H in this formula more or less than is in the similar formula of the above series, to or from the boiling point of its related compound. After pointing out similar relations in less extensive classes of substances, he calls attention to the importance of the boiling point of a substance in aiding us to determine its affinities. S. P. R.

NATURAL HISTORY SOCIETY.

The Natural History Society of Montreal, met on the evening of the 29th April, in their Rooms.

The Lord Bishop of Montreal presiding.

The following donations were presented and ordered to be acknowledged :—

Donations of Mammals and Birds from the Smithsonian Institution. 113 species, 148 specimens of birds, and 22 species, 30 specimens of mammals. A portion from Mr. Bernard Ross, Hudson's Bay Company. A report on this collection will be prepared by Mr. Alfred Rimmer.

A collection of Canadian Shells from the Geological Survey, to be placed in the Museum subject to specified conditions.

A pair of Snow-birds (*Niphea hiemalis*), from John J. Day, Esq.

A Shore Lark (*Alauda alpestris*), from Mr. Vennor.

Sir William Logan read a paper illustrated with diagrams, on the Quebec and Point Levi rocks. This paper is printed in the present number.

The next meeting of the Society to be held on the last Monday of the month of May. The Rev. Mr. Kemp to read a paper "On the Structure and Growth of *Zygnema*."

PUBLICATIONS RECEIVED.

1. Memoirs of the Literary and Philosophical Society of Manchester, England. Second series, vol. 15, containing among many articles worthy of note, a paper "On the yellow colouring matter obtained from the leaves of the *Polygonum fagopyrum* or common Buckwheat." At the conclusion it recommends that "in countries where the plant is cultivated it might be worth while to collect the leaves as a dyeing material."
2. Edinburgh New Philosophical Journal, vol. 12, No. 1.
3. The Geologist, vol. 4, Nos. 38. 39. 40. 41.
4. Journal of the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts. Third series, vol. 41, Nos. 2. and 6.
5. Proceedings of the Boston Natural History Society, vol. 7, pages 193 to 256, and pp. 417 to 448, with title page; also vol. 8, pp. 1 to 32.
6. Proceedings of the Academy of Natural Sciences of Philadelphia, 1859, pp. 327 to 356. 1860, pp. 1 to 324. 1861, pp. 1 to 96, with catalogue of the fishes of the eastern coast of America, from Greenland to Georgia, by Theodore Gill.

Report of the Regents of the University of the State of New York.

Proceedings of the American Antiquarian Society.

Historical Magazine (American).

Consolidated Statutes of Canada, from the Government.

Historical Collections of the Essex Institute.

Dr. Gibb on Canadian Caverns.

Harlan's Fauna Americana, 1 vol., from the Rev. A. F. Kemp.

List of Specimens presented to the Natural History Society, by A. S. Packard, Esq. Jr., of Brunswick, Maine.

1. Aporrhais occidentalis, Labrador.
2. Cardium islandicum, "
3. " pinnulatum, "
4. Tellina proxima, "
5. " fusca, "
6. Aphrodite groenlandica. "
7. Thyasira gouldii, "
8. Nucula tenuis, "
9. Leda tenuisulcata, "
10. Turritella erosa, "
11. " costulata, "
12. Littorina rudis, "
13. " littorea, "
14. " groenlandica? Greenland.
15. Bela turricula, Labrador.
16. Mangelia decussata, "
17. " pyramidalis, "
18. Tectura testudinalis, "
19. Margarita cinerea, "
20. " undulata, "
21. Lacuna vincta, "
22. Adeorbis costulata, "
23. Mangelia bicarinata, "
24. Margarita helicina, Greenland and Labrador.
25. Saxicava rugosa, "
26. Chiton marmoreus, "
27. Anomia ephippium, '
28. Pectinaria groenlandica, "
29. Anomia aculeata, "
30. Diadora noachina, "
31. Pecten magellancus, "'
32. Mesodesma arctata, "
33. Millepora polymorpha? "
34. Cardita borealis, Pleistocene from Labrador.
35. Astarte sulcata, " "
36. " compressa, " "
37. Turritella costulata " "
38. " erosa, " "
39. Mang. harpularia, " "
40. Diadora noachina, " "
41. Mang. turricula, " "
42. Trichotropis borealis" "
43. Pecten islandicus, Pleistocene from Brunswick, Maine.
44. Astarte sulcata, " " "
45. Balanus porcatus, " " "
46. Pandorina arenosa, " " "

47. Ophioglypha nodosa, Labrador.
48. Chiredole laeve, "
49. Hyas aranea, "
50. Cancer borealis, "
51. Crangon vulgaris, "
52. Echinarachnius atlanticus, "
53. Asteracanthion polaris, "
54. " rubens, "

With a number of fishes and reptiles from Labrador and crustaceans from Florida, and the following Batrachians :—

Salamandra dorsalis, Mass. S. coccinea, Mass. S. erythronota. S. bilineata.

ANNUAL MEETING.

The annual meeting of the Society was held pursuant to public notice, at the rooms of the Society, on Saturday evening, May 18, 1861, when there were present the following members :—

The President, the Lord Bishop of Montreal; Principal Dawson, Chairman of Council; Dr. DeSola, 1st Vice President; Dr. Hingston, Corresponding Secretary; John Leeming, Recording Secretary; James Ferrier, Jr., Treasurer; Dr. Craik, Curator; Messrs. Davies, Kemp, Murphy, of the Council; and Messrs. Gordon, Gouldie, Weaver, J. C. Becket, Dr. Jones, J. J. Day, Douglas, H. A. Joseph, D. Mackay, Alex. Morris, Gibson, Henry Rose, S. C. Bagg, and other members of the Society.

The minutes of the last annual meeting were read and confirmed.

His Lordship the President of the Society then delivered the following address :

Gentlemen,—Before we proceed to the more special business for which we are assembled at this the Annual General Meeting of our Society, I will ask your patience while as President of the Natural History Society of Montreal during the past year, I endeavour to lay before you some brief statements of what we have been doing, and what are our claims to support. We have a charter of Incorporation, and we receive support from the Legislature, upon the plea that we are promoting the study of Natural Science. It is very reasonable that such aid and encouragement should be given in a young country like this, but we can only expect it to be continued upon some good showing that we are accomplishing the work to which we are pledged. This I trust we can justly assert to be the case. But whatever help we may derive from the Legislature, it is rather upon the co-operation of our own members, that we must mainly and eventually rely, if we expect to advance our Institution or extend its usefulness. It is not however reasonable to anticipate any rapid accession

of members who will devote themselves systematically to scientific pursuits; but I think there is every reason to believe that the efforts of this Society are really advancing the cause of Science, and that its influence is becoming extended, and its labours more and more appreciated by the public. There are several ways in which the Society seeks to advance its work, and bring its influence to bear upon the public mind. First there is the Museum which occupies all the upper part of this building, and has received some very valuable additions recently, which will be noticed more particularly in the Report. This offers many objects of great interest in various departments, and has been visited by far larger numbers than in any previous year. Then there is the Somerville course of lectures during the Winter free to the public, and which have attracted such immense crowds this year that great numbers of persons have been unable to gain admittance. These Lectures bear in general a popular character; while at the monthly meetings of the Society there have been a number of very able and scientific papers read on various subjects. And lastly in order to give permanence to its labours, and disseminate its usefulness, the Society superintends a bi-monthly periodical, under the title of "The Canadian Naturalist." As to the Lectures delivered during the last year, they were attended by such large audiences, and were so well appreciated at the time, that I will not now delay you by alluding to them in detail. But the monthly meetings of the Society, which are truly the periods of its really scientific work, are not so largely attended, nor I think appreciated, as they deserve. And I should wish to mention some ot the many interesting papers which have been read and discussed by the members on these occasions; reminding you that these meetings are open to all members of the Society, and to all of their friends, ladies as well as gentlemen, whom they may wish to introduce.

GEOLOGICAL PAPERS.

1. *Poole, on Coal Field of Pictou.*—Giving many valuable new facts on a very important Coal district; a colossal specimen of the produce of which was exhibited in Montreal last summer at the great Industrial Exhibition.
2. *Honeyman, on new Localities of Fossils in Silurian rocks of Nova Scotia.*—Facts supplementary to, and extending those in Principal Dawson's paper of last year.
3. *Billings, on Fossils from Point Levi.*—This paper contained the discoveries on which the changes in the view entertained

of the Quebec group of rocks were mainly based. It marks an era in the Lower Silurian Geology of Canada, and illustrates the pre-eminent value of fossils as guides to the ages of rocks.

4. *Kemp, visit to Acton Copper Mine.*—A good popular exposition of the Geology of this very interesting mining district.
5. *Dawson, on the Earthquake of 17th October,* 1860.—A collection of facts relating to the shock as experienced in Canada; with notices of the general phenomena of Earthquakes, and of former Earthquakes in this Province.
6. *Billings, on certain theories of the formation of mountains.*—A very good exposition of the prevailing views, with some valuable theoretical deductions.
7. *Bradley, New Trilobite from Potsdam Sandstones.*—Supplementary to Mr. Billing's Paper, No. 3.
8. *Bell, on Freshwater Shells, in the Tertiary deposits of Canada.*—Interesting new facts respecting the fossils of the Pleistocene deposits; and tending especially to explain the peculiarities of those in Upper Canada, referred to in previous papers in the *Canadian Naturalist.*
9. *Dawson, on the Geology of Murray Bay.*—The local Geology of a very interesting region, showing the characters of several important formations in very good natural exposures.
10. *Logan, on the Lower Silurian Rocks of Lake Superior and Quebec.*—A lucid explanation of the new views entertained by Sir William Logan respecting the age of the Quebec group of rocks, and of the facts in the Silurian Geology of Lakes Huron and Superior, recently obtained by the Survey, with very importantgeneral deductions respecting the physical conditions of Eastern America during the Lower Silurian period.

ZOOLOGICAL PAPERS.

1. *Saunders, on* Menobranchus lateralis.—Interesting observations on the habits of a most curious Batrachian reptile.
2. *Vennor, on Birds wintering in and around Montreal.*—Some good observations by a very promising young naturalist; and showing a much larger number of winter residents and visitors than most persons are aware of.
3. *Ross, on Fur-bearing animals of the McKenzie River Settlement.*—Full of curious new facts about the habits of North American mammalia.

4. *D Urban, on the valley of the River Rouge.*—Giving catalogues of the animals of a district but little known.

ETHNOLOGICAL.

Dawson, on aboriginal Antiquities in Montreal.—An interesting paper respecting some Indian remains found in excavating for buildings near Sherbrooke Street, and tending to prove the site of the original Indian Village.

BOTANICAL.

D'Urban, on the Flora of the Counties of Argenteuil and Ottawa. —A valuable Catalogue of the plants of that part of Canada.

Under this head may also be placed a very interesting memoir and account of the labours of Douglas the great botanical explorer of the West coast of America.—By G. Barnston, Esq.

These papers contain a great deal of most interesting matter on a variety of subjects; and many of them are full of new facts bearing upon Natural History and Geology, and though they may be read afterwards in the pages of the "Naturalist," where, with many other valuable contributions, they are placed on record, yet to any young persons anxious to acquire any accurate knowledge, it would be far more profitable to attend the monthly meetings, at which they are read, because they might acquire much valuable information by conversation and enquiry, respecting details growing out of these subjects. And it is certain if a student once takes up a particular branch and follows it out systematically in detail, that an immense amount of interest is rapidly created; and by careful observation, without any great expenditure of time, he is soon able to contribute many useful facts for the enlargement or correction of our knowledge of Natural History. One great object of popular lectures, and public collections in Museums, is to excite such a taste for Natural Science, that in some persons at least a real interest may be created, and the study systematically pursued. Kindred Societies elsewhere in Canada are labouring in the same field, and each doing their part; let us rejoice with them in whatever success attends their efforts: such as the Canadian Institute of Toronto, the Historical Society of Quebec, and the Botanical Society of Kingston. And through the pages of the Montreal "Canadian Naturalist," our Society is now becoming known and valued far and wide by those who are well able to appreciate its worth. Many copies of every bi-monthly number are exchanged with other scientific Societies,

and its papers have again and again been copied, and most favorably noticed in the scientific publications of this Continent, of Great Britain, and the Continent of Europe. During the visit of the Prince of Wales to this city, we presented His Royal Highness with an address, and a copy of three volumes of *The Canadian Naturalist* already published, and also with a very handsome volume of curious meteorological observations by Dr. Smallwood, one of our members, which were graciously received and acknowledged. I feel that I may thus freely eulogize the labours of our Society, because while I have constantly attended to all its proceedings for some years past, and for the last two years have filled the office of your President, yet I can lay no claim to the honor of having contributed to the scientific work that has been accomplished. I cordially give my help to encourage what others, far abler in every department of science than myself, have achieved; and while such men as Sir William Logan, Principal Dawson, the Rev. A. F. Kemp, Mr. Billings, and others, continue to give their time and talents to its support, I am confident that it ought to receive cordial and liberal encouragement from the public of Montreal. It is an Institution which, though still in, what we may consider, an infant state, and with its Museum, as compared with those of the old world collections, only as it were commencing its existence, yet reflects credit upon this city, and I trust will continue to do so more and more. I certainly regret that we have not yet got in Montreal some regular and permanent building for carrying on Astronomical and Meteorological Observations. We are however now arrived at a time, when it is not unreasonable to expect occasional acts of well considered munificence amongst our wealthier citizens to enrich our city with useful Institutions, whether connected with Religion or Charity, Learning or Science; and I trust that the example recently set by one of them in connection with McGill College may lead to many similar instances. Perhaps amongst them we may some day find the means of establishing an Observatory in connection with this Institution, and carrying on a regular course of scientific observations. But at any rate whatever may be hereafter accomplished in any fresh departments, we must not allow the "Natural History Society of Montreal" to stop in its present onward progress, or to fail in making good its own special work, either for want of talent ready to labour in its cause, or a grateful public ready to support it.

Principal Dawson then read the following:—

Report of the Council.

The past year has been characterised by steady progress and prosperity in the affairs of the Society. The papers read have been numerous and important, the publication of the *Naturalist* has been maintained with its usual vigour, the annual course of Somerville lectures has been delivered to crowded audiences, considerable additions have been made to the library and museum, the number of members has increased, and the legislative grant and the increased amount of fees from members have much improved the financial position of the Society. Such details as are necessary under these heads may be stated as follows:—

PAPERS READ.

Since last annual meeting seventeen important papers have been read, all of which have been published in the *Canadian Naturalist and Geologist*, or are now in course of publication, and which have been noticed in detail in the address of the President.

Many other papers not read before the Society, especially a very valuable one by Mr. T. Sterry Hunt, and short notices on various subjects connected with Canadian Natural History, have been published. This Society may thus fairly take the credit of having been the medium through which in the past year many contributions of much importance have been made to Natural History and Geology.

PUBLICATION OF THE NATURALIST.

A very important movement in connection with the *Naturalist* is the employment of a portion of the Provincial grant to the Society in organising a system of exchanges with the leading scientific publications of Britain, America, and the continent of Europe. This will in the ensuing year publish more extensively than heretofore the matter contained in the *Naturalist.* It will afford a wider range of material for comment and selection; and will tend materially to the increase of the Library. It will also much extend the reputation of this Society and of Canadian Science in general; since wherever it is known, the *Naturalist* is now regarded as one of the most important representatives of Natural History on this continent.

While all the members of the Editing Committee have exerted themselves on behalf of the *Naturalist*, it is due to Mr. D. Allan Poe to state, that on him has fallen as heretofore the chief burden of editorial supervision, and that the Society is very much indebted to his exertions in this important part of its work.

MUSEUM AND LIBRARY.

The Reports of the Librarian and Curator and of the Library Committee have been submitted. The donations received have been numerous and valuable. The large collection of skins of birds and mammals presented by the Smithsonian Institution is especially deserving of notice, and will at an early meeting of the Society be made the subject of a special report by one of the members of Council. A very important contribution is also the deposit in our rooms through the kindness of Sir W. E. Logan, of a suite of specimens of the invertebrates recently collected by the Geological Survey. These are not a donation to the Society, but are placed in our rooms in order that they may be accessible to students, and that space may be made in the crowded apartments of the Geological Survey for its increasing collections of fossils. This is a gratifying proof of the public utility of the spacious Museum of this Society; and as the collection will be arranged for us by Mr. R. Bell, it will place within reach of the public, means of systematic study not previously enjoyed, in one leading branch of the Natural History of Canada, and will supply perhaps the greatest deficiency previously existing in our Museum.

It is due to Mr. Hunter, the cabinet keeper, to state that he has exerted himself most assiduously in the care of the collection, and also in preparing the numerous specimens presented to the Society.

PUBLIC LECTURES.

In pursuance of the requirement of the bequest of the late Rev. A. Somerville, the annual course of free lectures was opened on Thursday, February 21st, by an address on the objects and prospects of the Society, by the President, the Lord Bishop of Montreal. It consisted of the following lectures:—

1. By Principal Dawson, on the Aboriginal Antiquities of Montreal.

2. By the Rev. Dr. De Sola, on the Arts and Sciences of the Ancient Hebrews.

3. By Wm. H. Hingston, M.D., on the climate of Canada in its relation to life and health.

4. By Ed. Murphy, on the Microscope and Microscopic research.

5. By Alfred Rimmer, on Sea Birds and their habits.

6. By Dr. Wilkes, on Natural Heritage.

GENERAL AFFAIRS OF THE SOCIETY.

Twenty-eight ordinary members, and six corresponding members have been added to our number during the year.

The usual petition to the Legislature having been prepared, and the Recording Secretary having personally called on members of the Government therewith, the Council have much pleasure in reporting that the sum of $1,000 has been placed on the estimates as the annual grant to the Society.

The Treasurer's account appended to this report, shows a most gratifying condition of the financial affairs of the Society. The debt on the building has been reduced to an amount not greater than that on the old building of the Society, the liabilities having in the past year been reduced by $755.19. All the minor accounts have been paid, and there is a prospect that the Society may be able still further to reduce the permanent debt, as well as to carry on its operations with increased vigour.

For the better securing of this last object, the Council would recommend, as necessary to the Society in its present stage of advancement, and as warranted by its financial position, the appointment of some gentleman of scientific tastes and knowledge, as Assistant Secretary and Curator, with a small salary. The great services of Mr. D'Urban in this capacity, are fresh in the memory of the Society, and there are now among our members, several young naturalists of ability and high promise, who could very much benefit the Society and the cause of science, if enabled in this way, to devote a part of their time to its interests. It would be the duty of such an officer to prepare the programme of scientific business for each meeting, to write out the proceedings in a form suitable for publication, to determine and arrange specimens presented to the Society, to take measures for the increase of the collection and library, and generally to work out all the details of our scientific operations, which are now necessarily conducted in a very desultory manner. The Council would ask authority from the Society, to engage some person of the requisite zeal and scientific and business knowledge, as soon as possible, and at a rate of remuneration such as the resources of the Society could afford.

Signed, J. W. Dawson,

Chairman of the Council.

THE NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAMES FERRIER, JUNR., TREASURER.

Recapitulation.

1861.		Dr. $ cts.
	To balance due the Treasurer, May 1, 1860,.	126 28
May 1.—	" cash for salary to Mr. Hunter,..........	200 00
"	" " " C. McCormick, $30, and G. Appleton, $30, commissions,.....	60 00
"	" " " city assessment,..............	150 00
"	" " " gas and water rent,...........	44 70
"	" " " fuel,........................	125 97
"	" " " advertising and printing,.......	260 06
"	" " " books and binding,............	41 46
"	" " " repairs and fixtures,...........	288 70
"	" " " interest,......................	482 50
"	" " " insurance,...................	38 00
"	" " " incidental expenses,...........	66 33
		$1884 00
	To balance due the Treasurer,........	173 25

Recapitulation.

1861.		Cr. $ cts.
May 1.—	By cash received from annual subscriptions and diplomas,...............	557 00
"	" " received from Dr. Hingston for life membership,................	50 00
"	" " received from admission fees to museum,....................	66 25
"	" " interest returned on loan paid before maturity,...............	37 50
"	" " annual grant from government,...	1000 00
"	" balance due the Treasurer,..........	173 25
		$1884 00

E. & O. E.

JAMES FERRIER, JR.,
Treasurer, N. H. S.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF FEBRUARY, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	29.512	29.612	29.924	17.1	20.6	20.0	.078	.085	.091	.83	.78	.85	N. E by E.	N. E. by E.	N. E. by E.	277.46	6.5	....	1.75	Snow.	Sleet.	Cu. Str. 10.
2	482	495	601	19.0	20.1	20.6	.087	.091	.085	.84	.85	.78	N. E. by E.	N. N. E.	S. W.	110.10	5.5	....	....	Cu. Str. 10.	"	" 10.
3	30.064	30.184	30.331	7.8	6.0	— 9.6	.040	.035	.022	.64	.61	.78	N. by W.	W. by N.	S. S. W.	269.40	4.0	....	....	" 6.	Clear.	Clear. Zod. light. bright.
4	245	137	170	—11.3	0.9	1.1	.014	.038	.038	.68	.85	.54	E. by N.	N. E.	N. E.	28.60	4.5	....	0.70	Clear.	Cu. Str. 10.	Cu. Str. 9. Rain in night.
5	29.612	000	29.914	24.2	29.9	23.0	.123	.136	.106	.93	.84	.86	S. W.	S.	S. W.	13.74	4.6	Inapp.	....	Cu. Str. 10.	" 10.	Snow.
6	30.157	29.408	463	7.2	39.3	24.6	.042	.142	.094	.70	.84	.73	S. S. W.	W. S. W.	S. by W.	280.56	4.0	....	1.00	" 10.	" 10.	Cu. Str. 10.
7	29.424	517	880	— 6.0	— 6.0	—21.8	.024	.022	.011	.70	.68	.64	N. E. by E.	N.	N. by W.	657.10	3.5	....	1.60	Snow.	Heavy drift.	Loud and Heavy drift.
8	30.214	30.307	30.388	—3[illegible]. 1	—14.1	—19.6	.001	.011	.012	.09	.74	.67	W. by S.	W. S. W.	W. S. W.	444.80	8.0	....	....	Clear.	Clear.	Clear.
9	585	537	392	—24.0	0.0	— 7.0	.009	.027	.019	.60	.61	.60	W. S. W.	N. E. by E.	N. E. by E.	98.40	3.0	....	....	"	C. C. Str. 4.	Cu. St. 10.
10	162	114	094	7.0	27.2	31.9	.045	.105	.152	.76	.80	.89	N. E. by E.	S.	E.	118.60	3.6	....	....	Sleet.	Sleet.	Slight Raio.
11	170	29.956	29.770	27.2	44.3	40.1	.127	.240	.226	.86	.82	.91	N. E. by E.	E. S. E.	E. S. E.	80.10	6.0	0.121	....	Slight Rain.	Cul. Str. 10.	Cu. Str. 10.
12	29.631	371	448	39.4	43.7	36.2	.210	.248	.190	.86	.87	.88	S. S. E.	S. S. W.	W. S. W.	74.50	6.0	0.640	....	Cu. St. 10.	" 10.	Clear. Aurora Borealis.
13	571	819	30.061	32.9	30.8	21.6	.147	.142	.100	.81	.80	.79	W. S. W.	W. S. W.	W. S. W.	170.80	2.5	....	....	C. C. Str. 8.	" 10.	"
14	30.088	30.201	174	8.4	33.8	22.4	.048	.144	.095	.97	.75	.80	W.	W.	N. E. by E.	39.80	3.0	....	....	Clear.	Clear.	Cu. Str. 10.
15	29.914	29.720	29.499	19.6	22.5	19.9	.081	.084	.051	.77	.71	.77	N. E. by E.	N. E by E.	N. E. by E.	457.70	4.6	....	2.10	Nim. 10.	Snow.	Snow.
16	504	614	651	9.0	29.4	20.4	.051	.138	.085	.37	.82	.78	N. E. by E.	N. E. by E.	N. E. by E	250.80	4.5	....	1.46	Snow.	Cu. Str. 4.	Light Cirr. 2.
17	125	101	350	27.6	31.8	31.1	.141	.149	.140	.91	.84	.80	N. E. by E.	W. by N.	S. W.	196.50	6.0	....	7.26	"	Snow.	Cu. Str. 10.
18	502	852	718	21.7	31.2	23.7	.090	.136	.100	.78	.77	.79	W.	W.	N. by W.	247.70	4.0	....	....	Cu. Str. 10.	Cu. Str. 10.	C. C. Str. 8.
19	819	850	7.7	9.4	34.1	11.8	.050	.155	.051	.70	.79	.76	W. S. W.	S. S. W.	N. E. by E.	43.10	8.0	....	....	Clear.	C. C. Str. 4.	Cirr. 4.
20	584	300	267	14.1	29.8	24.1	.063	.148	.111	.80	.89	.86	N. E. by E.	N. E. by E.	W. S. W.	100.00	3.0	....	6.51	Snow.	Snow.	Cu. Str. 10.
21	812	541	841	26.0	27.4	11.1	.111	.123	.057	.81	.82	.79	W. S. W.	W. S. W.	W. by N.	245.40	3.0	....	....	C. C. Str. 10.	Cu. St. 6.	C. C. Str. 4.
22	977	965	989	— 1.0	11.0	2.0	.028	.048	.034	.68	.69	.71	W. by N.	W.	W.	258.89	2.0	....	....	Cum. 2.	Clear.	Cirr. 2. Lunar Halo.
23	30.030	844	495	3.0	8.4	6.0	.036	.042	.043	.72	.66	.75	N. E. by E.	N. E. by E.	N. E. by E.	228.20	6.0	....	5.47	Cu. Str. 10.	Snow.	Snow.
24	29.371	711	30.090	16.1	16.1	6.7	.074	.074	.037	.83	.83	.62	W.	W. by N.	W. by N.	418.00	3.5	....	....	Clear.	Cum. 4.	Cirr. Str. 2.
25	30.104	30.060	29.954	2.0	32.0	25.2	.034	.119	.117	.71	.84	.87	W. N. W.	S. W.	S. by E.	233.30	2.0	....	....	"	Clear.	C. C. Str. 10.
26	29.827	29.757	30.061	27.4	35.4	32.5	.123	.177	.156	.84	.85	.85	W. S. W.	W.	S. W.	177.90	3.0	....	....	"	Cu. Str. 10.	Cu. Str. 6.
27	30.189	30.063	039	17.2	53.2	40.2	.079	.328	.225	.82	.85	.89	S. S. E.	W. S. W.	W. S. W.	4.30	2.0	....	....	"	Clear.	Clear. Aurora Borealis.
28	010	000	29.910	30.2	58.1	38.0	.147	.348	.193	.89	.86	.88	S. W.	S. by W.	S. by W.	126.00	2.0	....	....	"	"	Cu. Str. 10.

REPORT FOR THE MONTH OF MARCH, 1861.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	29.801	29.904	29.905	34.4	48.4	35.0	.169	.260	162	.84	.78	.80	N. N. E.	S. W.	S. W.	133.20	8.5	....	....	Cu. Str. 9.	C. C. Str. 6.	C. Str. 9. Aurora borealis.
2	862	804	732	31.4	43.4	36.1	.149	.193	.170	.84	.71	.80	S. by W.	S. by W.	N. E. by E.	10.60	4.5	Inapp.	....	" 10.	C. Str. 10.	Cu. Str. 10.
3	474	247	415	34.5	41.4	39.0	.182	.228	.201	.94	.87	.88	N. E. by E.	W.	W. S. W.	46.80	6.5	0.747	....	Rain.	" 10.	Clear.
4	30.454	30.371	549	31.4	34.6	29.0	.142	.169	.129	.84	.84	.82	W. S. W.	W. S. W.	W.	270.70	3.0	....	....	Clear.	Cu. Str. 2.	Scud. 4.
5	29.674	29.716	824	9.0	30.4	15.2	.051	.136	.070	.77	.83	.82	W.	W.	W. S. W.	274.00	8.0	....	....	Cu. Str. 10.	" 4.	Clear.
6	816	450	716	16.7	21.6	12.8	.058	.074	.081	.75	.64	.71	S. W.	W.	W.	299.10	4.5	....	0.96	Snow.	Snow.	Slight Snow.
7	30.190	30.188	30.398	—11.4	8.0	0.0	.020	.032	.030	.70	.60	.64	W. by N.	W. S. W.	W. S. W.	370.00	2.5	....	....	Clear.	Clear.	Clear.
8	327	120	29.810	— 1.0	26.6	29.8	.030	.117	.136	.69	.82	.83	S. E. by E.	S. S. E.	S. S E.	180.90	3.5	....	....	"	C. C. Str. 8.	C. C. Str. 4.
9	29.650	29.431	320	34.2	35.6	33.1	.182	.169	.168	.95	.83	.89	S. S. E.	W.	W.	120.70	7.6	0.264	0.77	Rain.	Rain.	Cu. Str. 10.
10	550	727	30.076	29.4	29.1	19.1	.136	.112	.077	.84	.86	.76	W. S. W.	W. S. W.	W. S. W.	272.10	6.0	....	1.40	C. C. Str. 8.	Cu Ct Str. 3.	Clear.
11	30.117	30.100	040	— 1.1	30.9	17.7	.028	.140	.072	.68	.85	.75	W.	W.	S. S. E.	60.20	3.0	....	....	Clear.	Clear.	C. C. Str. 10.
12	29.664	060	147	21.4	27.0	10.4	.085	.117	.050	.78	.82	.80	S. S. E.	W.	S E. by E.	319.80	4.5	....	1.04	Str. 4.	"	Clear.
13	939	000	167	10.6	22.6	18.4	.054	.095	.077	.78	.79	.76	S. S. E.	W. by S.	W. S. W.	232.90	7.5	....	3.07	Snow.	Snow.	Cu Str. 8. Aurora borealis.
14	30.273	214	120	— 4.0	21.9	6.5	.024	.074	.032	.61	.64	.60	N. W. by N.	N. E. by E.	N. E. by E.	14.60	3.0	....	....	Clear.	Clear.	" 2. " "
15	137	29.958	000	1.0	32.5	16.1	.040	.137	.070	.85	.74	.80	N. E. by E.	S. by W.	S. S. W.	17.10	2.5	....	....	"	"	Str. 2. " "
16	29.753	401	29.450	— 1.0	36.7	29.9	.031	.170	.130	.70	.80	.78	N. W.	S. by N.	S. S E.	27.80	2.0	Inapp.	....	"	Cirr. 6.	Slight Rain.
17	820	30.040	30.220	— 5.0	7.3	— 2.9	.022	.037	.032	.63	.62	.82	W.	W.	N. N. W.	343.50	2.0	....	....	"	Clear.	Clear.
18	30.497	420	500	—16.4	12.9	— 4.2	.012	.045	.024	.69	.60	.65	W.	S. W.	S. S. W.	66.90	2.0	....	....	"	"	"
19	543	330	198	—17.1	15.9	1.6	.003	.059	.026	.12	.66	.56	N. E. by E.	N. E. by E.	N. by E.	103.60	2.0	....	....	"	"	"
20	277	247	138	— 3.7	31.9	7.0	.031	.136	.037	.83	.78	.64	N. E. by E.	N. E. by E.	N. E. by E.	10.90	1.0	....	....	"	"	Cirr. 4. Lunar Halo.
21	29.905	29.000	29.914	6.0	20.0	25.0	.040	.075	.101	.75	.71	.76	N. E. by E.	N. E. by E.	N. E. by E.	27.60	4.0	....	1.10	C. Str. 10.	Snow.	C. C. Str. 6.
22	30.028	30.011	30.000	18.6	47.1	27.9	.077	.273	.123	.76	.85	.88	N. E. by E.	S. W. by W.	W. S. W.	35.20	3.0	....	....	Cu. Str. 6.	Clear.	Clear.
23	29.948	29.741	29.542	15.2	48.4	39.0	.061	.260	.201	.74	.78	86	E. S. E.	E. by N.	S.	70.80	2.5	....	....	Clear.	Cir Cum. 4.	Cu. Str. 10.
24	460	576	864	31.0	32.8	26.4	.058	.156	.117	.85	.85	.83	S.	W. S. W.	N. W.	372.60	2.0	....	....	C. C. Str. 4.	Cu. Str. 10.	Clear.
25	30.176	30.040	920	14.4	36.9	32.1	161	.156	.162	.74	.75	87	W. S. W.	S. E. by E.	E. S. E.	111.20	2.0	....	....	Clear.	C. C. Str. 4.	C. C. Str. 10.
26	29.890	29.746	748	29.4	34.6	33.7	.148	.162	.162	.89	.83	.84	N. E. by E.	N. E. by E.	N. E. by E.	152.80	6.5	0.510	....	Cu. Str. 10.	Rain.	Rain.
27	524	476	618	33.4	38.1	37.8	.168	.208	.193	.89	.91	88	N. E. by E.	N. E. by E.	S. S. W.	209.50	4.0	0.235	....	" 10.	Fog.	Cu. Str. 10.
28	781	950	30.060	20.0	34.2	29.0	.081	.155	.129	.77	.79	.82	W.	W.	W. S. W.	618.70	3.0	....	....	" 4.	Clear.	Clear. Aurora borealis.
29	30.214	814	29.770	21.1	39.0	33.1	.081	.158	.168	.77	68	.89	N. E. by E.	N. E. by E.	N. E. by E.	335.20	6.0	....	....	Cirr. 4.	Cu Cirr. 4.	Sleet.
30	29.198	697	30.134	40.5	38.7	29.3	.219	.180	.136	.87	.77	.83	W. S. W.	W.	N. W.	187.50	3.5	....	....	Rain.	C. C. Str. 6.	Cirr. 4. Aurora borealis.
31	428	441	599	15.0	32.4	20.4	.061	.137	.081	.78	.74	.77	N. E. by E.	E. S. E.	S. by W.	72.20	2.0	....	....	Clear.	" 6.	Clear.

REMARKS FOR FEBRUARY, 1860.

Barometer .... Highest, the 9th day, 30·585 inches.
Lowest, the 17th day, 29.101 "
Monthly Mean, 29.750 "
" Range, 1·484 "

Thermometer ... Highest, the 20th day, 55°2.
Lowest, the 8th day,—37°1.
Monthly Mean, 18°25.
Monthly Range, 90°3.

Greatest intensity of the Sun's rays, 80°1.
Lowest point of Terrestrial radiation,—39°4.
Mean of Humidity, .755.
Rain fell in 3 days, amounting to 0.761 of an inch; it was raining 17 hours and 25 minutes.

Snow fell on 9 days, amounting to 27·85 inches; it was snowing 73 hours and 45 minutes.
Most prevalent wind, the N. E. by E.
Least prevalent wind, the E.
Most windy day the 7th day, mean miles per hour, 23.12.
Least windy day the 7th day, mean miles per hour, 0.17.
Aurora Borealis visible on 2 nights.
Lunar Halo visible on 1 night.
Zodiacal Light bright.
Crows 1st seen on the 27th day.
The Electrical state of the Atmosphere has indicated constant and moderate intensity.

REMARKS FOR MARCH, 1861.

Barometer. ...... Highest, the 31st day, 30.599 inches.
Lowest, the 30th day, 29.198 "
Monthly Mean, 29.878 "
Monthly Range, 1·401 "

Thermometer. Highest, the 1st day, 48°4.
Lowest, the 10th day,—17°1.
Monthly Mean, 21°94.
Monthly Range, 65°5.

Greatest intensity of the Sun's rays, 76°6.
Lowest point of terrestrial radiation,—19°7.
Mean of humidity, .768.
Rain fell on 6 days, amounting to 1.756 of an inch; it was raining 62 hours 35 minutes.

Snow fell on 8 days, amounting to 8.34 inches, it was snowing 40 hours and 15 minutes.
Most prevalent wind, the N. E. by E.
Least prevalent wind, the E. by N.
Most windy day, the 28th day; mean miles per hour, 95.77.
Least windy day, the 2nd day; mean miles per hour, 0.61.
Aurora Borealis visible on 6 nights.
Lunar Halo visible on 1 night.
Imperfect Solar Halo the 31st day.
Zodiacal light was bright.
The Electrical state of the Atmosphere has indicated moderate intensity.

THE

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ARTICLE XV.—*Notes on the History of Petroleum or Rock Oil.* By T. Sterry Hunt, M.A., F.R.S., of the Geological Survey of Canada.

Public attention has lately been drawn to the petroleum furnished by the oil wells in Canada and the United States, and we have therefore thought it well to bring together some few facts which may serve to explain the origin of this and of similar substances, including naphtha, petroleum or rock oil, and asphalt or mineral pitch, all of which are forms of bitumen, the one being solid and the others fluid at ordinary temperatures. These differences are, in many cases at least, due to subsequent alterations; the more liquid of these substances are mixtures of oils differing in volatility, and by exposure to the air become less fluid, and partly by evaporation, partly by oxydation from the air, eventually become solid and are changed into mineral pitch. These substances, which are doubtless of organic origin, occur in rocks of all ages, from the Lower Silurian to the tertiary period inclusive, and are generally found impregnating limestones, and more rarely, sandstones and shales. Their presence in the lower palæozoic rocks, which contain no traces of land plants, shows that they have not been in all cases derived from terrestrial vegetation, but may have been formed from marine plants or animals: the latter

is not surprising when we consider that a considerable portion of the tissues of the lower marine animals is destitute of nitrogen, and very similar in chemical composition to the woody fibre of plants. Besides the rocks which contain true bitumen we have what are called bituminous shales, which when heated burn with flame, and by distillation at a high temperature yield, besides inflammable gases,a portion of oil not unlike in its characters to petroleum. These are in fact argillaceous rocks intermixed with a portion of organic matter allied to peat or lignite, which by heat is decomposed and gives rise to oily hydrocarbons. These inflammable or lignitic shales, which may be conveniently distinguished by the name of *pyroschists*, (the *brandschiefer* of the Germans) are to be carefully distinguished from rocks containing ready-formed bitumen; this being easily soluble in benzole or sulphure of carbon can be readily dissolved from the rocks in which it occurs, while the pyroschists in question yield, like coal and lignite, little or nothing to these liquids.

It is the more necessary to insist upon the distinction between lignitic and bituminous rocks, inasmuch as some have been disposed to regard the former as the source of the bitumen found in nature, which they conceive to have originated from a slow distillation of these matters. The result of a careful examination of the question has however led us to the conclusion that the formation of the one excludes more or less completely that of the other, and that bitumen has been generated under conditions different from those which have transformed organic matters into coal and lignite, and probably in deep water deposits, from which atmospheric oxygen was excluded. Thus in the palæozoic strata of North America we find in the Utica and Hamilton formations, highly inflammable pyroschists which contain no soluble bitumen, and the same is true to a certain extent of some limestones, while the Trenton and Corniferous limestones of the same series are impregated with petroleum or mineral pitch, and as we shall show, give rise to petroleum springs. The fact that intermediate porous strata of similar mineral characters are destitute of bitumen, shows that this material cannot have been derived from overlying or underlying beds, but has been generated by the transformation of organic matters in the strata in which it is met with. This conclusion is accordance with that arrived at by Mr. S. P. Wall in his recent investigations in Trinidad. He has shown that the asphalt of that island and of Venezuela belongs to strata of the

tertiary formation (of upper miocene or lower pliocene age,) which consist of limestones, sandstones and shales, associated with beds of lignite. The bitumen is found not only in the famous pitch lake, but *in situ*, where it is confined to particular strata which were originally shales containing vegetable remains; these have undergone "a special mineralization producing a bituminous matter instead of coal or lignite. This operation is not attributable to heat, nor of the nature of a distillation, but is due to chemical reactions at the ordinary temperature, and under the normal conditions of climate." He also describes wood partially converted into bitumen, which last when removed by solution leaves a portion of woody tissue. (Proc. Geol. Soc. London, May, 1860.)

The sources of petroleum and mineral pitch in Europe and in Asia, are for the most part, like those just named, confined to rocks of newer secondary and tertiary age, though they are not wanting in the palæozoic strata, which in Canada and the United States furnish such abundant supplies of petroleum. In the great palæozoic basin of North America bitumen, either in a liquid or solid state, is found in the strata at several different horizons. The forms in which it now occurs depend in great measure upon the presence or absence of atmospheric oxygen, since by oxydation and volatilization the naphtha or petroleum, as we have already explained, becomes slowly changed into asphalt or mineral pitch, which is solid at ordinary temperature. It would even appear that by a continuance of the same action the bitumen may lose its fusibility and solubility, and became converted into a coal-like matter. Thus in the Calciferous sandrock in New York a black substance, which has been called anthracite, occurs in cavities with crystals of bitter spar and quartz. It sometimes coats these crystals or the walls of the cavities, and at other times appears in the form of buttons or drops, evidently according to Mr. Vanuxem, having been introduced into these cavities in a liquid state, and subsequently hardened as a layer above the crystals, which have conformed to them, showing that this coal-like matter was once in a plastic state. It is very pulverulent, brittle, of a shining black, and according to Vanuxem yielded but little ash, and 11½ per cent of volatile matter, which he regarded as water, (Vanuxem, Geology of New York, iii. 33). A similar material occurs in the Quebec group in Canada, the equivalent of the Calciferous sand-rock, and fills cavities and fissures in the limestones, sandstones, and even in the accom-

panying trap rocks, as at Quebec, Orleans Island, Point Levis, and at Acton, presenting mamillary surfaces as noticed by Vanuxem, which evidently show that it has once been semi-fluid. This matter from the first two localities is completely infusible, and insoluble in benzole; it readily crumbles between the fingers and gives a very black powder. When exposed to a high temperature it gives off abundance of inflammable strong smelling vapors, which condense into a tarry oil, and leaves a black residue, which when heated slowly burns away, leaving only a trace of ash. The volatile portion is equal to from 19.5 to 21.0 per cent. The mineral from the Acton copper mine is much harder and less friable, and approaches to anthracite in its characters. When heated it gives off watery vapor without any bituminous odor. Its loss by heat was 6.9 per cent, and the residue of ash was equal to 2.2 per cent.

An evidence of the presence of unaltered petroleum in almost all the Lower Silurian limestones is furnished by the bituminous odor which they generally exhibit when heated, struck or dissolved in acids. In some cases petroleum is found filling cavities in these limestones, as at Rivière à la Rose (Montmorenci,) where it flows in drops from a fossil coral of the Birdseye limestone, and at Pakenham, where it fills the cavities of large orthoceratites in the Trenton; from some specimens nearly a pint of petroleum has been obtained; it is also said to occur in the township of Lancaster in the same formation. The presence of petroleum in the Lower Silurian rocks of New York is shown in the township of Guilderland near Albany, where according to Beck, considerable quantities of petroleum are collected upon the surface of a spring which rises through the Hudson River or Loraine shales. On the Great Manitoulin Island also according to Mr. Murray, a petroleum spring issues from the Utica state, and he has described another at Albion Mills near Hamilton rising through the red shales of the Medina group; these have probably their origin in the Lower Silurian limestones, which may in some localities prove to be valuable sources of petroleum.

In the Upper Silurian and Devonian rocks bitumen is much more abundant; Eaton long since described petroleum as exuding from the Niagara limestone, and this formation throughout Monroe county in western New York is described by Mr. Hall as a granular crystalline dolomite including small laminæ of bitumen, which give it a resinous lustre. When the stone is burned for

lime the bitumen is sometimes so abundant as to flow like tar from the kiln. In the Corniferous limestone, at Black Rock on the Niagara River, petroleum is described as occurring in cavities, generally in the cells of fossil corals, from which, when broken, it flows in considerable quantities. It also occurs in similar conditions in the Cliff limestone (Devonian) of Ohio.

Higher still in the series, at the base of the Hamilton group, occur what in New York have been called the Marcellus shales; these enclose septaria or concretionary nodules which contain petroleum, while at the summit of the same group similar concretions holding petroleum are again met with. The sandstones of the Portage and Chemung group in New York are in many places highly bituminous to the smell, and often contain cavities filled with petroleum, and in some places seams of indurated bitumen. A calcareous sandstone from this formation at Laona near Fredonia in Chatauque county contains more than two per cent of bituminous matter. At Rockville in Alleghany county, according to Mr. Hall, the same standstones are highly bituminous and give out a strong odor when handled, and in the counties of Erie, Seneca and Cataraugus abundant oil springs rise from the sandstones and have been known to the Seneca Indians from ancient times. In the northern part of Ohio, according to Dr. Newberry, petroleum is found to exude in greater or less quantity from these sandstones wherever they are exposed, and the oil wells of Pennsylvania and Ohio are sunk in these Devonian sandstones, often through the overlying carboniferous conglomerate, and in some cases apparently, according to Newberry, through the sandstones themselves, which are supposed by him to be only reservoirs in which the oil accumulates as it rises through fissures from a deeper source, in proof of which he mentions that in boring wells near to each other, the most abundant flow of oil is met with at variable depths. In some instances the petroleum appears to filter slowly into the wells from the porous strata around, which are saturated with it, while at other times the bore seems to strike upon a fissure communicating with a reservoir which furnishes at once great volumes of oil. An interesting fact is mentioned in this connection by Mr. Hall. In the town of Freedom, Catarragus Co., New York, is a spring which had long been known to furnish considerable quantities of petroleum. On making an excavation about six yards distant, to the depth of fourteen feet, a copious spring of petroleum arose, and for some time afforded large

quantities of oil, after which the supply diminished in both the old and new springs, so that it is now less than at the first settlement of the country. Notwithstanding its general distribution throughout a considerable region in the adjacent portions of New York, Pennsylvania and Ohio, it is only in a few districts that it has been found in quantities sufficient to be wrought with profit. The wells of Mecca in Trumbull Co., Ohio, have been sunk from 30 to 200 feet in a sandstone which is saturated with oil; of 200 wells which have been bored, according to Dr. Newberry, a dozen or more are successfully wrought, and yield from five to twenty barrels a day. The wells of Titusville on Oil Creek, Pennsylvania, vary in depth from 70 to 300 feet, and the petroleum is met with throughout. The oil from different localities varies considerably in color and thickness, and in its specific gravity, which ranges from 28° to 40° Baumé, (from ·890 to ·830.)

The valley of the Little Kenawha in Virginia, which is to be looked upon as as an extension of the same oil-bearing region, contains petroleum springs, which so long ago as 1836, according to Dr. Hildreth, yielded from fifty to a hundred barrels yearly. It here rises through the carboniferous strata, and as elsewhere is accompanied by great quantities of inflammable gas.

The black inflammable shales of the Devonian series in western Canada which were formerly referred to the Hamilton group, and are now considered to belong to the base of the overlying Portage and Chemung, appear at Kettle Point on Lake Huron and in portions of the region southward to Lake Erie, but the oil wells sunk in Enniskillen show that the source of the oil is really below the horizon of these shales, inasmuch as the underlying argillaceous shales and limestones of the Hamilton group are there found near the surface, and have been penetrated 120 feet, at which depth oil is still met with, leaving but little doubt that it is derived from the limestones beneath, which both in New York, and in Canada are impregnated with petroleum. A somewhat slaty brownish-black bituminous dolomite belonging to the Corniferous limestone from Pine Creek near Alma, in Kincardine, gave me not less than 12.8 per cent. of bitumen, fusible and readily soluble in benzole, and another from the Grand Manitoulin Island, which was a brown crystalline dolomite, yielded from 7.4 to 8.8 per cent. of similar bitumen. The solid form of this bitumen at the outcrop of the rocks, is probably due to the action of the air.

The existence of liquid bitumen in the Corniferous limestone in western Canada was pointed out as long ago as 1844 by Mr. Murray, who tells us that this rock is generally bituminous, and that cavities in it are often filled with petroleum; the quarries near Gravelly Bay in Wainfleet are cited as an example, (Report of Geol. Survey, 1846, p. 87). In the Report for 1850 we find a notice of what are called oil springs, in which petroleum rises to the surface of the water near the right bank of the Thames in Mosa, and in two places on Bear Creek in Enniskillen. Subsequently Mr. Murray described a considerable deposit of solid bitumen or mineral tar, which occurs in the same township, extending over about half an acre, and in some places two feet in thickness, doubtless formed by the drying-up of petroleum springs (Report for 1851, p. 90.) I had already in the Report for 1849, p. 99, described this bitumen from specimens in the Museum of the Geological Survey, and called attention to its economic applications, remarking that "the consumption of this material in England and on the continent for the construction of pavements, for paying the bottoms of ships, and for the manufacture of illuminating gas is such that the existence of these deposits in the country is a matter of considerable importance." At this time solid bitumen was thus employed, but in the liquid form of petroleum its use was chiefly confined in Europe to medicinal purposes. Under the names of Seneca oil and Barbadoes tar it had long been known and employed medicinally by the native tribes of America. Its use for burning, as a source of light or heat, in modern times has been chiefly confined to Persia and other parts of Asia, although in former ages the wells of the island of Zante described by Herodotus furnished large quantities of it to the Grecian Archipelago, and Pliny and Dioscorides describe the petroleum of Agrigentum in Sicily, which was used in lamps under the name of Sicilian oil. The value of the naphtha annually obtained from the springs at Bakoum in Persia on the Caspian sea was some years since estimated by Abich at about 600,000 dollars, and the petroleum wells of Rangoon in Burmah are said to furnish not less than 400,000 hogsheads yearly. In the last century the petroleum or naphtha obtained from springs in the Duchy of Parma was employed for lighting the streets of Genoa and Amiano. But the thickness, coarseness and unpleasant odor of the petroleum from most sources were such that it had long fallen into disuse in Europe, when in 1847, the attention of Mr. Young, a manufacturing

chemist of Glasgow, was called to the petroleum which had just been obtained in considerable quantities from a coal mine at Riddings in Derbyshire, from which by certain refining processes he succeeded in preparing a good lubricating oil. This source however soon becoming exhausted, he turned his attention to the somewhat similar oils which Reichenbach and Selligue had long before showed might be economically obtained by the distillation of coal, lignite, peat and pyroschists. To this new industry Mr. Young gave a great impetus, and in connection with it attention was again turned to the refining of liquid and solid bitumens, it being found that the latter by distillation gave great quantities of oils identical with those from petroleum. About the year 1853 the attention of speculators was turned to the deposits of bitumen in Enniskillen just described, but it was not till 1857, that Mr. W. M. Williams of Hamilton, with some associates undertook the distillation of this tarry bitumen, when they soon found that by sinking wells in the clay beneath, it was possible to obtain great quantities of the material in a fluid state. Large numbers of wells were subsequently sunk by Mr. Williams and others in the southern part of the township of Enniskillen along the borders of Black Creek, and also about ten miles farther north on Bear Creek. Nearly one hundred wells had been sunk when I visited the place in December last, and many more have since been bored. Of these but a small proportion furnish available quantities of oil, but the whole amount already obtained from the district is perhaps not less than 300,000 or 400,000 gallons. Owing to the difficulties of communication and of procuring casks sufficient for the oil, these wells have not yet been wrought in a coutinuous manner; large quantities of oil are however taken out at intervals of some days, and it is probable that if continuously worked the supply would be still greater. Here as in Pennsylvania considerable variations are found in the quality of the oil; that from the wells on Black Creek is more liquid and less dense than the oil from Kelly's wells on Bear Creek, and it is said that wells recently sunk to a considerable depth in the rock have yielded an oil still thinner, lighter colored and less dense, which is prized as being more profitable for refining. The present wholesale price of the crude oil from Kelly's wells, delivered at the Wyoming station on the Grand Trunk Railway, is about thirteen cents a gallon. The oil obtained by Mr. Williams is refined in Hamilton, while that from the northern

part of the township has hitherto been sent to Boston, though refining works are now being erected at the wells. The process of refining consists in rectifying by repeated distillations, by which the oil is separated into a heavier part employed for lubricating machinery, and a lighter oil, which after being purified and deodorized by a peculiar treatment with sulphuric acid, is fit for burning in lamps.

These wells occur along the line of a low broad anticlinal axis which runs nearly east and west through the western peninsula of Canada, and brings to the surface in Enniskillen the shales and limestones of the Hamilton group, which are there covered with a few feet of clay. The oil doubtless rises from the Corniferous limestone, which as we have seen contains petroleum; this being lighter than the water which permeates at the same time the porous strata, rises to the higher portion of the formation, which is the crest of the anticlinal axis, where the petroleum of a considerable area accumulates and slowly finds its way to the surface through vertical fissures in the overlying Hamilton shales, giving rise to the oil springs of the region. The oil is met with at various depths; in some cases an abundant supply is obtained at forty feet, while near by it is only met with at three or four times that depth, and sometimes only in small quantities. Everything points to the existence of separate fissures communicating with a deep-seated source. At Kelly's wells however, it would appear that a reservoir has been formed much nearer the surface, where in a bed of gravel and boulders, underlying the superficial clays, the oil rising from the rocks beneath has accumulated. The inflammable gas which issues from the wells is not necessarily connected with the petroleum, inasmuch as it is an almost constant product of the decomposition of organic matters, and is copiously evolved from rocks which are destitute of bitumen. It is similar to the gas of marshes and to the fire damp of coal mines. A curious circumstance is however noticed by Mr. Robb; the gas which accumulates in the oil pits, becomes charged with vapors which produces upon the workmen a sort of intoxication like nitrous oxyd.* This is not surprising when we remember that volatile hydrocar-

* Mr. Charles Robb, C.E., has published in the Canadian Journal for July an interesting paper on the oil wells of Enniskillen, to which, as also to a paper by Prof. E. B. Andrews of Ohio, in Silliman's Journal for July I am indebted for several facts.

bons like amylene, closely related to the hydrocarbons of petroleum, produce similar effects when their vapor is respired.

The oil wells of the United States are for the most part sunk in the sandstones which form the summit of the Devonian series, but the oils of western Virginia and southern Ohio rise through the coal measures which overlie the Devonian strata, while the wells of Enniskillen are situated much lower, and are sunk in the Hamilton shales, which immediately overlie the Corniferous or Devonian limestone. It is not impossible that in Ohio some of the higher strata, such as the sandstone, were originally impregnated with bitumen, but in Canada from the absence of this substance diffused through the shales in question, we are forced to assign it to a lower horizon, which is doubtless that of the bituminous Devonian limestone. This view I have for some time maintained in opposition to those who conceive the bitumen to be derived from the black pyroschists; see my lecture before the Board of Arts, reported in the Montreal Gazette of March 1, where I asserted that the source of the petroleum was to be sought in the bituminous Devonian and Silurian limestones; besides the Corniferous limestone (Devonian,) we have shown that both the Niagara and the Trenton, (of Upper and Lower Silurian age,) contain petroleum. The question of the extent of the supply of petroleum is not easily answered; the oil now being wrought is the accumulated drainings of ages, concentrated along certain lines of elevation, and the experience of other regions has shown that these sources are sooner or later exhausted; but though the springs of Agrigentum, like those of Derbyshire, have nearly ceased to flow, those of Burmah and Persia still furnish, as they have for ages past, immense quantities of oil; nothing but experience can tell us the richness of the subterranean reservoirs. It is not probable that the Devonian limestone is equally rich in petroleum throughout its whole distribution, but the exposures of it in the west are too few to enable us as yet to say in what portions the petroleum predominnates; as however this rock underlies more than one-half of the western peninsula, we may look for petroleum springs much farther east than Enniskillen. A well yielding considerable quantities of petroleum is said to occur in the township of Dereham, about a quarter of a mile S. W. of Tilsonburg, and we may reasonably expect to find others along the line of the anticlinal, or of the folds which are subordinate to it.

It is now many years since Sir William Logan described the occurrence of petroleum springs in Gaspé, and collected specimens of the oil, which are preserved in the Geological Museum. One of these, near Gaspé Bay, is described as occurring on the south side of the St. John's River about a mile and a half above Douglastown, where it may be collected by digging pits in the mud on the beach. Another locality is about 200 yards up a small fork of the Silver Brook, which falls into the Southwest Arm six or seven miles above Gaspé Basin. The oil collects in pools along the stream, and may be gathered in considerable quantities. The cavities in a greenstone dyke on Gaspé Bay were also found to be filled with petroleum, and the odor of it from the rock was perceived at a considerable distance. The dyke, which marks a fold in the stratification, runs in the direction of the petroleum springs, and the evidences of the distribution of petroleum are thus, as Sir William Logan has remarked, visible along a line of twenty miles (Report for 1844, p. 41.) Attention has recently been drawn to these indications, and a company formed with a view of exploring this region for petroleum. Here, as well as in western Canada and the United States, the connection is evident between the springs and undulations of the strata which favor the accumulation of the petroleum.

Supplementary Note.

We have stated in the preceding paper that the different mineral combustibles have been derived from the transformations of vegetable matters, or in some cases of animal tissues analogous to these in composition. The composition of woody fibre or cellulose, in its purest state, may be represented by $C_{24}H_{20}O_{20}$, or as a compound of the elements of water with carbon: the incrusting matter of vegetable cells, to which the name of lignine has been given, contains however a less proportion of oxygen and more carbon and hydrogen than cellulose, so that the mean composition of recent woods, as deduced from numerous analyses of various kinds, may be represented by $C_{24}H_{18.4}O_{16.4}$. We may conceive of four different modes of transformation of woody fibre, all of which probably intervene to a greater or less degree in the production of mineral combustibles; and in considering

these changes we shall for greater simplicity adopt for the composition of woody fibre the first named formula, $C_{24}H_{20}O_{20}$.

I. When wood is exposed to the action of moist air, oxygen is absorbed, and carbonic acid and water are evolved in the proportion of one equivalent of the first for two of the last. We may suppose that for H_2 which is oxydised by O_2 from the air, the wood loses CO_2, so that while the carbon increases in amount the proportions of oxygen and hydrogen are unchanged. In this way an equivalent of cellulose, by absorbing sixteen equivalents of oxygen and losing eight of carbonic acid, ($8\ CO_2$) and sixteen of water, ($16\ HO$) would leave $C_{16}H_4O_4$. Such is the nature of the decay of wood when exposed to the air, and the process, could it be carried out, would leave a residue of carbon only. If however the wood is deeply buried and excluded from the oxygen of the air two reactions are conceivable.

II. The whole of the oxygen of the wood may be given off in the form of carbonic acid, while the hydrogen remains with the residual carbon. The abstraction of ten equivalents of carbonic acid from one of woody fibre, would leave a hydrocarbon, $C_{14}H_{20}$.

III. Instead of combining exclusively with the carbon, a part of the oxygen of the wood may be set free as water, in combination of the hydrogen. The abstraction from an equivalent of woody fibre of four equivalents of carbonic acid and twelve of water would leave a hydrocarbon $C_{20}H_8$.

IV. These decompositions are however never so simple as we have supposed in II and III, for a portion of hydrogen is at the same time evolved in combination with carbon, chiefly as marsh gas, C_2H_4. The amount of this gas evolved from decaying plants submerged in water, and the immense quantities of it condensed in coal beds and other rocky strata, (forming fire damp,) shew the great extent to which this mode of decomposition prevails.

In nature these various modes of decomposition often go on together, or intervene at different stages in the decomposition of the same mass; they are besides seldom so complete as we have represented them. The first process results in the formation of vegetable mould, which always retains portions of carbon and hydrogen; while the incomplete operation of the processes II, III and IV gives rise to peat, lignite, brown coal, bituminous coal and pyroschists, in all of which the proportion of the oxygen is much less than the hydrogen, so that their composition may be

approximately represented by mixtures of hydrocarbons with vegetable fibre. The following results have been selected from a great number of analyses by various chemists, and are for the most part taken from Bischof's *Chemical Geology*, (Vol. i. cap. XV.) The nitrogen, which in most cases was included with the oxygen in the analysis, has been disregarded, and the oxygen and hydrogen for the sake of comparison, have been calculated for twenty-four equivalents of carbon.

1.	Vegetable fibre or cellulose,		$C_{24}H_{20}O_{20}$
2.	Wood, mean composition,		$C_{24}H_{18\cdot4}O_{16\cdot4}$
3.	Peat,	(Vaux,)	$C_{2}\ H_{14\cdot4}O_{10}$
4.	do.	(Regnault,)	$C_{24}H_{14\cdot4}O_{9\cdot6}$
5.	Brown coal,	(Schrötter,)	$C_{24}H_{14\cdot3}O_{10\cdot6}$
6.	do. do.	(Woskresensky,)	$C_{24}H_{13}O_{7\cdot6}$
7.	Lignite,	(Vaux,)	$C_{24}H_{11\cdot3}O_{6\cdot4}$
8.	do. passing into mineral resin,	(Regnault,)	$C_{24}H_{15}O_{3\cdot3}$
9.	Bituminous coal,	do.	$C_{24}H_{1}\ O_{3\cdot3}$
10.	do. do.	do.	$C_{24}H_{10}O_{1\cdot7}$
11.	do. do.	do.	$C_{24}H_{8\cdot4}O_{1\cdot2}$
12.	do. do.	do.	$C_{24}H_{8}O_{0\cdot9}$
13.	do. do.	(Kühnert and Gräger,)	$C_{24}H_{7\cdot4}O_{1\cdot3}$
14.	do. do. (mean comp.)	(Johnston)	$C_{2}\ H_{9}O_{2}—O_{4}$
15.	Albert coal,	(Wetherell,)	$C_{24}H_{15\cdot9}O_{1\cdot6}$
16.	Asphalt, Auvergne,		$C_{24}H_{17\cdot7}O_{2\cdot2}$
17.	do. Naples,		$C_{24}H_{14\cdot6}O_{2}$
18.	do. Bastennes,		$C\ _{4}H_{1}\ O_{0\cdot7}$
19.	Elastic bitumen, Derbyshire,	(Johnston,)	$C_{24}H_{22}O_{0\cdot3}$
20.	Bitumen of Idria,		$C_{24}H_{8}$
21.	Petroleum and naphtha,		$C_{24}H_{24}$

In the above table we see the transition from peat and brown coal to lignite, and thence to bituminous coal. Prof. Johnston from his experiments in various coals, including cannel from Wigan, splint coal from Workington and caking coal from Newcastle, deduced the composition given in 14, in which with $C_{24}H_{9}$ the oxygen varies from two to four equivalents. It will be seen from a comparison of the infusible Albert coal with the bitumens 16, 17 and 18, how gradual is the transition to the true petroleums and naphthas, from which oxygen is absent. The asphalts also, as will be observed, differ very much in their composition, and though generally much richer in hydrogen than the bituminous coals, the variety from Naples (17) which is completely fusible at 140° C., contains less hydrogen and more oxy-

gen than the Albert coal analysed by Wetherell; while the idrialine or bitumen found with the mercury ores of Idria, approaches very nearly in composition to the bituminous coals 11, 12 and 13, with which many asphalts may be said to be isomeric. It is however probable that those oxygenized bitumens, unlike the coals, are products of the oxydation of naphtha or petroleum, by a process similar to that by which resins are derived from vegetable hydrocarbons. These formulas must be taken as representing not the true equivalents, but only the proportions of the elements in the bodies in question, which are in most cases mixtures of various substance. This is especially true of naphtha, which may be taken as the representative of pure unoxydised petroleum, and which is separated by distillation into oils of very different boiling points. The late analyses by Uelsmann of the rectified rock oil from Sehnde near Hanover, gave the formula $C_{18}H_{20}$, and according to De la Rue and Müller the greater part of the Rangoon petroleum consists of hydrocarbons in which the number of equivalents of hydrogen is a little greater than the carbon; one gave $C_{26}H_{28}$. Associated with these are however portions of bodies containing a less proportion of hydrogen, so that we may conceive the mean composition of petroleum to be represented, as in the preceding table, by equal equivalents of hydrogen and carbon; many forms of solid bitumen also, as ozokerite and hatchetine, have the same general composition.

By referring to what has been said above it will be seen that the final result of the third process of decomposition of woody fibre, in which the air being excluded, the oxygen is shared between the carbon and hydrogen, would be $C_{20}H_8$. A similar result would be obtained, with the simultaneous evolution of marsh gas, if we suppose $6\ CO_2 + 8\ HO + 3\ CH_2$ to be removed from an equivalent of woody fibre, leaving $C_{15}H_6 = C_{20}H_8 = C_{24}H_{9.5}$, which approaches the composition of most bituminous coals and of idrialine. A farther elimination of marsh gas would leave a residue of pure carbon, and thus, as Bischof has suggested, vegetable matters may be converted into anthracite without the intervention of a high temperature.

The elimination of the whole of the oxygen in the form of carbonic acid would leave a compound with a large excess of hydrogen, of which it would be necessary to remove a portion in the form of water or marsh gas in order to reduce the residue to the composition of petroleum. We know of no combination

of carbon and hydrogen in which the number of atoms of hydrogen surpasses by more than two, those of hydrogen, the general formula being $CnHn_{+2}$, so that oils like $C_{18}H_{20}$ and $C_{26}H_{28}$ contain nearly the maximum quantity of hydrogen, and a body like $C_{14}H_{20}$, whose formation we have supposed above, could not exist, but must break up into marsh gas and some less hydrogenous oil like petroleum.

We do not know the precise conditions which in certain strata favor the production of petroleum rather than of lignite or coal, but in the fermentation of sugar, to which we may compare the transformations of woody fibre, we find that under different conditions it may yield either alcohol and carbonic acid, or butyric and carbonic acids with hydrogen, and even in certain modified fermentations the acetic, lactic and propionic acids, and the higher alcohols, like $C_{10}H_{12}O_2$. These analogies furnish suggestions which may lead to a satisfactory explanation of the peculiar transformation by which, in certain sedimentary strata, organic matters have been converted into bitumen.

ARTICLE XVI.—*Remarks on some of the Birds that breed in the Gulf of St. Lawrence.* By Henry Bryant, M.D.

(*Extracted from the Proceedings of the Boston Natural History Society, Vol.* 8.)

The trip to Labrador, made by me the past summer, for the purpose of procuring specimens of the eggs of those sea-birds that breed there, and also to ascertain what changes, if any, had taken place in their economy since Audubon's visit, was unfortunately delayed till the 21st of June, so that the results were much less satisfactory than I hoped to have obtained. Instead of visiting Anticosti and the whole of the North shore, I was compelled to sail directly to the Bird Rocks, thence to Romaine, the nearest point on the North shore, and from thence, following the shore line, to Chateau Beau at the outlet of the Straits of Belle Isle, the farthest point reached.

The season was remarkably stormy and cold, and I was informed by every one that such an inclement one had not been known for years. This also delayed my progress and added much to the difficulty of making researches, as many of the breeding places of this class of birds are accessible only in pleasant weather.

We sailed from Gaspé on the 21st, and arrived at the Bird Rocks on the morning of the 23rd ; these are two in number, called the Great Bird or Gannet Rock, and the Little or North Bird ; they are about three quarters of a mile apart, the water between them very shoal, showing that, at no very distant epoch, they formed a single island. They are composed entirely of a soft, reddish-brown sandstone, the strata of which are very regular and nearly horizontal, dipping very slightly to the S. W. The North Bird is much the smallest, and though the base is more accessible, the summit cannot, I believe, be reached, at least, I was unable to do so ; it is the most irregular in its outline, presenting many enormous detached fragments, and is divided in one place into two separate islands at high water ; the northerly one several times higher than broad, so as to present the appearance of a huge rocky pillar. Gannet Rock is a quarter of a mile in its longest diameter from S. W. to N. E. The highest point of the rock is at the northerly end, where, according to the chart it is 140 feet high, aud from which it gradually slopes to the southerly end, where it is from 80 to 100.

The sides are nearly vertical, the summit in many places overhanging. There are two beaches at its base on the southerly and westerly sides, the most westerly one comparatively smooth and composed of rounded stones. The easterly one, on the contrary, is very rough and covered by irregular blocks, many of large size and still angular, showing that they have but recently fallen from the cliffs above. This beach is very difficult to land on, but the other presents no great difficulty in ordinary weather; the top of the rock cannot, however, be reached from either of them. The only spot from which at present the ascent can be made, is the rocky point between the two beaches; this has probably, from the yielding nature of the rock, altered materially since Audubon's visit; at present, it would be impossible to haul a boat up from want of space. The landing is very difficult at all times, as it is necessary to jump from a boat, thrown about by the surf, on to the inclined surface of the ledge, rendered slippery by the fuci which cover it, and bounded towards the rock by a nearly vertical face. The landing once effected, the first part of the ascent is comparatively easy, being over large fragments and broad ledges, but the upper part is both difficult and dangerous, as in some places the face of the rock is vertical for eight or ten feet and the projecting ledges very narrow, and the rock itself so soft that it

cannot be trusted to, and in addition rendered slippery by the constant trickling from above and the excrements of the birds that cover it in every direction.

Since Audubon's time the fishery, which was carried on extensively in the neighborhood of Bryon Island, has failed, or at least is less productive than on the North shore, and I am inclined to think that at present the birds are but little disturbed, and that consequently their number, particularly of the Guillemots, has much increased. There was no appearance of any recent visit on the top of the rock, and though after making the ascent it was obvious that others had preceded us, still the traces were so faint that it was several hours before we succeeded in finding the landing-place. The birds breeding there, at the time of our visit, were Gannets, Puffins, three species of Guillemots, Razor-billed Auks, and Kittiwakes. These birds are all mentioned by Audubon, with the exception of Brünnich's Guillemot, and the Bridled Guillemot confounded by him with the common species. No other breeding-place on our shore is so remarkable at once for the number and variety of the species occupying it.

Of the seven species mentioned, I am not aware that three, namely, the Kittiwake and the Bridled and Brünnich's Guillemot, are known to breed at any other place south of the Straits of Belle Isle; of the remaining four, two, the Foolish Guillemot and Razor-billed Auk, are found at many other places and in large numbers; the Puffin in much greater abundance on the North shore, particularly at the Perroquet Islands, near Mingan and Bras D'Or; the Gannet at only two other points in the Gulf, at Percé Rock near Gaspé, which is perhaps even more remarkable than Gannet Rock, but is at present inaccessible; and at Gannet Rock near Mingan, which will soon be deserted by those birds in consequence of the depredations of the fishermen.

The following list of birds is not intended to comprise all those observed by me,—all the land birds are omitted, as well as those water birds to our present knowledge of which I could add nothing. Before leaving home I had flattered myself that I should have an opportunity of seeing some of the rarer Rapacious birds, or the Iceland or Greenland Falcon, Duck Hawk, &c. Strange as it may seem, during the whole of my visit to the North Shore, I saw only a single bird of this class—a fine Golden Eagle at Bras D'Or. I mention this, not as proof that those birds are unknown, for I frequently found on the shores unmistakable evidence

of their visits, but to show with how much caution the results of any individual's experience should be received as positive evidence in Natural History.

As Audubon has generally given the average dimension only of the eggs of the birds described by him, which affords but a very incorrect idea of the variation in size and shape, I have made careful measurement of the extremes in length, breadth, and size of the eggs of all the varieties procured by me, not, however, including those which were evidently abnormal. In this class, I found eggs of the common Cormorant and Herring Gull; they were not more than one quarter of the average size, without exception contained nothing but albumen, and the shell was remarkably thick and strong. One egg of the Cormorant was not symmetrical in its longitudinal axis, and had the appearance of having been deposited in a soft state on a convex surface; in other respects it presented nothing remarkable. I have been lead to make these remarks because Naumann, in his description of the eggs of *Uria troille*, states that the eggs of very small size are found, caused by the birds laying more than their normal number. I do not think that this is the cause, as the eggs found by me were in nests with other eggs that presented no deviation from the ordinary shape or size.

Sometaria mollissima, Linn. This bird though constantly harassed by the fishermen and inhabitants, still breeds in great abundance along the whole extent of the North shore, and, as it is not gregarious during the breeding season, and ranges over such an immense extent of island and shore, it will probably continue to do so, even if unprotected, for many years. I found but few of their nests, placed under the shelter of the dwarf firs and junipers; their favourite breeding-blaces seemed to be the small grassy islands found in bays, and particularly those where small spots of turf were protected by a rock from the prevailing wind. On many of the islands a species of umbelliferous plant grows abundantly, the thick foliage of which forms an admirable shelter that they gladly avail themselves of. It is not often that many nests are found on one island; from one to a dozen is the ordinary number, though on Greenlet Island, in the Straits of Belle Isle, I found over sixty, probably not more than a quarter of the whole number, as two other persons besides myself were searching for them at the same time, and it is not probable that all the nests would be discovered; indeed, I found nearly as many returning

as on first going over the ground. This island is, however, peculiarly adapted to their wants, being covered with a thick growth of the plant above mentioned, hardly elevated above the water and at a sufficient distance from the main land to prevent it being often visited by the inhabitants. I found on this island a nest in a small stone hut, made for the purpose of concealing the hunters in the spring, at which time they shoot immense numbers of the Eider or Sea Ducks, as they call them.

I found many nests in which the down was quite clean, and am inclined to believe that it is always so if the bird is undisturbed; but after having been frequently robbed, the supply not being sufficiently great, it is forced to eke it out with the most convenient substitute, and late in the season it is not at all uncommon to find nests without any down. I found some containing fresh eggs, and others that had just been finished after the middle of July, and many birds had already hatched their brood by the first, it is probable that others had made at least three nests that season. Audubon states that the eggs are deposited on the grass, &c., of which the nest is principally composed. I did not see an instance, where there was any down, that this was the case. Nearly every day, during the first week or two, I found nests containing one, two, three, or more freshly laid eggs lying on a bed of down so exquisitely soft and warm that, in that almost painfuly barren and frigid region, it was the ideal of comfort, almost of beauty. When the bird leaves her nest without being suddently disturbed, I believe the eggs are generally covered with down, always so after the full complement has been laid. The largest number of eggs found by me in a nest was six, and this in so many instances that I am inclined to think it the normal number; in color, they present two varieties, one of a pale greenish-olive or oil green, and the other a brownish or true olive; the former are frequently marked with large spots or splashes of the same color of much greater intensity; the latter are invariably unspotted. After the eggs have been incubated for some time, they are always more or less scratched and marked, probably by the claws of the bird while sitting on them or rolling them over. In shape they present little variety, being always nearly oval; the diameter is considerable. In size, the difference is perhaps less than in the majority of birds.

Four selected eggs measured as follows: 75 x 47 mill,—83 x 55 —17x 44—75 x 47. Of these the first was the most elongated;

the 2d, the largest; the 3d, the most broadly oval, and the last the smallest.

Sula bassana, Linn. The northerly or highest half of the summit of Gannet Rock, and all the ledges on its sides of sufficient width, the whole upper part of the pillar-like portion of the Little Bird, and the greater part of the remaining portion of this rock, were covered with the nests of the Gannet at the time of my visit. On the ledges the nests were arranged in single lines nearly or quite touching one another; on the summit, at regular distances one from the other of about three feet. Those on the ledges were built entirely of sea-weed and other floating substances; on the summit of the rock they were raised on cones, formed of earth or small stones, about ten inches in height and eighteen in diameter when first constructed, presenting, at a short distance, the appearance of a well-hilled potato field. I saw no nests built of zostera, or grass, or sods; the materials were almost entirely fuci, though anything available was probably used; in one case the whole nest was composed of straw, and in another, the greater part of manilla rope-yarn.

The nests on the summit of the Great Bird were never scattered, but ended abruptly in as regular a line as a military encampment. Through the midst of the nests were several open spaces, like lanes, made quite smooth by the continued trampling of the birds, which seemed to be used for play-grounds; these generally extended to the brink of the precipice, and reminded me very much of the sliding places of otters.

The birds were feeding principally on herring, but also on capelin filled with spawn, some fine-looking mackerel, a few squids, and, in one instance, a codfish weighing at least two pounds. The surface was swarming with a species of staphylinus that subsisted on the fish dropped by the birds. Occasionally, a nest could be seen in which the single egg had not been deposited, and perhaps one, in two or three hundred, with a newly laid one; on all the rest the Gannets were already sitting, and though none of the eggs were as yet hatched, many of them contained fully formed chicks. On being approached the birds manifested but slight symptoms of fear, and could hardly be driven from their nests; occasionally one more bold would actually attack us. Their number on the summit could be very easily and accurately determined by measuring the surface occupied by them; by a rough computation I made it to be about fifty thousand pairs, and probably

half as many more breed upon the remaining portion of the rock and on the Little Bird.

All the birds I saw were in adult plumage, differing in this respect from those breeding in the Bay of Fundy, where many were young birds. The egg of the American bird has not, I think, been described. Audubon was unable, on account of the weather, to ascend the rock, and I think his description was without doubt taken from a European specimen.

In shape and general appearance the egg is more like that of the brown Pelican than of any other North American bird, and it is sometimes stained with blood, as that commonly is. The cretaceous or calcareous coating is thicker than it is on the egg of any other bird that I am acquainted with, and it is very generally marked with scratches and furrows, as if deposited in a soft state; in one specimen this coating is two millimetres in thickness, nearly one twelfth of an inch; so that the egg, though emptied of its contents, feels nearly as heavy as an ordinary one that has not been blown. In shape there is a greater tendency to elongation or flattening of the ellipse than in the Pelicans. The color when first laid is a chalky white, which soon becomes a dirty drab.

Four eggs selected from many hundreds gave the following measurements: 89 x $45\frac{1}{2}$ mill.—84 x 52—66 x 48—$67\frac{1}{2}$ x 42.

Phalacrocorax carbo, Linn. On the 26th of June I had the pleasure of visiting, for the first time, a breeding-place of this species. It was situated on the south side of the rocky wall that bounds the gulf at Wapitaguan, and is probably much the same as it was twenty-seven years ago at the time of Audubon's visit; it extends for nearly half a mile along the face of the cliff, which is there from a hundred to a hundred and fifty feet in height, not perfectly vertical, but falling back slightly towards the land as it rises. Although not by any means easy of access, it is yet much less dangerous than Gannet Rock, as the smallest projection can be depended on, and the rough surface of the granite enables one to crawl over it without fear of slipping. As the eggs are not considered worth collecting, and it requires a good deal of time and patience to ascend the precipice, the birds had not, I think, been disturbed before my visit. The nests were built precisely as described by Audubon, and placed wherever there was any room for them. Some of them contained half-grown young, and others were but just finished, but by far the larger number either young

or eggs that were nearly hatched. I did not see a single bird that had more than the merest trace of the long white feathers of the neck and thighs, The full number of eggs is four, and, excepting when first laid, they are filthy in the extreme. In shape they are more regular than in the Florida Cormorants, but less so than in the double-crested, the only species of this genus with whose eggs I am sufficiently acquainted to properly compare them. The calcareous coating of this egg, as also of that of the *dilophus*, is much softer than that of the *Floridanus*, and can readily be rubbed off with the fingers; in some specimens it is quite thick, and is frequently deposited in irregular sheets, or even lumps. The birds were very tame, and, though they flew off on our approach, returned to their nests the moment we moved to another spot. On alighting on the sides of the precipice they cling to it with their tail and claws, much like swifts or woodpeckers, and before alighting almost always swooped down nearly to the surface of the water and then rose in a curved line to the surface of the cliff, without moving their wings, and almost with the regularity of a pendulum. Though these birds breed on many other points on the coast, I did not find them in as large numbers anywhere else. The number at Wapitaguan was from 4,000 to 5,000.

Four eggs measured as follows: 71 x 40 mill.—64 x 40—63 x 43—67½ x 43½.

Phalacrocorax dilophus, Swains. This species, so closely resembling the Florida Cormorant, I found breeding only at one place, Wapitaguan; it was not so abundant as the *P. carbo*, being in the proportion of about one of the present to four of the other. The northerly part of the breeding-place was occupied exclusively by the present species, the central part by both, and the southerly by the common species only. Though so early in the season, there was hardly a trace of the crest remaining on any of the birds. Their nests were apparently as bulky as those of the common species, and as they are certainly occupied for more than one year, I am inclined to think it not uncommon for the nest built by one species to be occupied by the other the next season. As a general rule, they preferred the lowest ledges, where the two species were breeding in common; but the highest nest of all was one of the present species. Where the ledge was long enough to admit of several nests, they were generally occupied by the same species; where there were only two or three, much more frequently by the two. In one or two places near the summit, where the rock was broken in such

a way as to present a series of little niches, they seemed to alternate, as if by design. The two species were evidently on terms of perfect friendship, and when not sufficiently near to be distinguished by color or size, no difference could be detected in their habits or motions. The nests contained the same variety of eggs and young as those of the preceding species; if anything, the number of newly laid eggs was proportionably less. The eggs, four in number, were of a more regular oval, but otherwise similar in appearance, and the difference in size by no means proportioned to that of the birds themselves. At the time of Audubon's visit none of the present species were seen at Wapitaguan, and he says that he never found them breeding on precipices, but always on flat rocks. I was unable to visit the breeding-place mentioned by him, near Cumberland Harbor, though I passed near, both going and returning, and even remained two days at *Tête de Baleine*, in hopes that the sea might go down sufficiently to make it possible to land on the rock.

Four eggs gave the following measurements: 62½ x 36½ mill.—57 x 40½—56 x 38—59 x 39.

Thallassidroma Leachii, Bon. These birds were frequently seen but do not breed in numbers or in many places on the North shore. I found them but at two places, on Gull Island, at Romaine, and on a small island between Mecattina and Bras D'Or. As the opposite shore of Newfoundland is lower, and the islands less rocky, it probably breeds there. On the Atlantic shore it is found breeding everywhere that a suitable island exists, from Mount Desert, in Maine, to the Straits of Belle Isle. At Romaine the eggs were but just laid on the 26th of June.

Puffinus——? Shearwaters were very numerous in the Straits, and as at that time they must have been feeding their young, their breeding-places were probably at no very great distance. Owing to the stormy weather I was unable to procure a specimen so as to identify the species, and did not succeed in finding their breeding-place. None of the inhabitants, questioned by me, had ever found the egg or knew anything about their breeding-place.

Lestris arcticus. Also very abundant in the Straits, but not found breeding.

Larus marinus, Linn. This beautiful and powerful Gull we found breeding on almost all the grassy islands North of Romaine in greater abundance as we approached the Straits. I saw nothing in its habits not already well known. I am sure, however,

that it has been represented as much more rapacious and tyrannical than it deserves to be. On Greenlet Island, which I have already mentioned as the abode of great numbers of Eider Ducks, I found twenty-two nests of this bird, among the number one not a foot from the nest of an Eider, both containing eggs. I did not see a single egg-shell or any apperance of any eggs having been destroyed by the Gulls. On all the islands where the Herring Gulls breed, this species is found in greater or less numbers, apparently on as good terms with them as with its own species. I saw no peculiarity in its flight, and have often watched one for some time to ascertain what species it belonged to, before a good look of his black back betrayed it.

The nest is much oftener placed on the bare rock than that of the following species, and is not unfrequently found singly on some small rocky island, which the other never is. The eggs are three in number, and are generally easily distinguished from those of the Herring Gull by the color as well as size. The spots are generally fewer in number and much larger, and this is almost a specific character.

The dimensions of four were as follows: 81 x 50 mill.—69 x 51½—70 x 57—69½ x 59.

Larus argentatus, Brünn. This bird was not found by Audubon breeding anywhere on the coast of Labrador. I can hardly attempt to account for this. It is difficult to believe that a bird, now one of the most abundant on the coast, breeding on nearly all the grassy islands, and which the inhabitants state to have always been abundant, could have been overlooked by Audubon; still, this is the most probable supposition, and he mentions, as a fact, something that would seem to favor this view, namely, that the Black-backed Gulls change their plumage so as to resemble large Herring Gulls.* I visited probably thirty breeding-places of this bird, between Romaine and Chateau Beau, at all of which there were Black-backed Gulls in greater or less abundance, but in the whole of this distance found but one spot on which the Black-backed Gulls were breeding by themselves in a greater number than one, or, at most, two pairs.

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*"The most remarkable circumstance relative to these birds is that they either associate with another species, giving rise to a hybrid brood, or that when very old they lose the dark color of the back, which is then of the same tint as that of the *Larus argentatus*, or even lighter." *Aud. Birds of America* 8vo. vol 7, p. 178.

As the islands on which these birds breed are all known by the inhabitants, and the eggs and young are both favorite articles of food, they are much harassed by them. At Flat Rock, for instance, where many of these birds breed, on the 26th of July there were from fifty to sixty young birds, the greater number of which, as well as all the eggs, were carried off, and many of the old birds shot by a party of eight whalers, who landed on the island at the same time with ourselves. Nothing remarkable was observed in their method of building their nests. The eggs are subject to a larger amount of variation in form and color than those of most of the genus; the large spots found in the Saddle-back are seldom seen.

Four of them measured as follows: 73 x 44 mill.— 67 x 49— 55 x 48—78 x 52.

Alca torda, Linn. This species, though abundant, is probably less numerous than the Foolish Guillemot; it is, however, much more generally distributed, and breeds on almost all the rocky islands in greater or less numbers, even on those at some distance from the open waters of the Gulf, which the *U. troille* I believe never does.

The eggs can generally be easily distinguished from those of the Guillemots, though some of the latter are so similar that I think they cannot be determined with positive certainty. Naumans says that they can be distinguished by the spots being always shaded on their edges with reddish-brown. This is not strictly true, and I have seen eggs of the Guillemots in which the spots were similarly shaded. The number of eggs is stated by Audubon to be two; though I have seen hundreds of them, I never found more than one laid by the same bird, and in no instance anything like a nest. The greatest number found breeding at any one place, was on an island called Tête de Baleine, near the Fox Islands. From the eggs being generally deposited in cracks and fissures, or under projecting masses of rock, they are more difficult to be obtained, and consequently the birds are not so much disturbed as the Guillemots. In the ninth volume of the Pacific R. R. Survey, it is stated that the white line from the nostril to the eye is never absent in this bird in any state of plumage. Naumann says, on the contrary, that in the first plumage it is nearly impossible to distinguish it from the young *U. arra*. I have a fine adult specimen in winter plumage, and also a young bird of the year, without a trace of the white line.

Four eggs measured as follows: 71 x 43½ mill.—75½x 49—83½ x 47½—80½ x 49.

Uria grylle, Linn. Breeding everywhere in abundance. One specimen had the posterior edges of the upper mandible and the lower edges of the rami of the under mandible deep red. I never found more than two eggs laid by the same bird, On July 3rd, on a small island where there was no appearance of the birds having been disturbed, the greater number had but just commenced incubating, and none of the eggs were hatched.

Four eggs measured: 57 x 36 mill.—55 x 38—51 x 37—58 x 39.

Uria troille, Linn. The most common bird on the Labrador coast,—breeding at various points, from the southern extremity of Nova Scotia to the entrance to Hudson's Bay. From the number in which they asssmble at their chosen breeding-places, the eggers and fishermen are enabled to collect their eggs with great ease; the extent to which these birds are persecuted may be imagined from the fact that, though on the 23rd of June young birds were common at Gannet Rock, where they are but little if at all disturbed, up to July 20th I saw but one young bird on the Labrador coast. At the Murre Rock, so famous at the time of Audubon's visit for the number of Guillemots breeding there, on the 2nd of July not more than a hundred eggs could be collected, and apparently not over a thousand birds were breeding on it, probably not a hundreth part of their former numbers. On account of the violence of the sea, I was unfortunatety unable to visit the Foxes, as they are called, a short distance north of the Murre Rocks, and at present said to be their favourite breeding-place. Naumann in his description of the eggs of this bird states that he has never seen an unspotted specimen. I have several in my possession, and it would be strange if in a bird, whose eggs are so extremely varied in their coloration, they should not occasionally be found of a uniform color.

Four eggs measured as follows: 84 x 47 mill.—47 x 51—84 x 51—78 x 45.

Uria ringvia, Brünn. As this bird was unfortunately confounded by Audubon with the preceding species, it is at present impossible to ascertain what were its limits or numbers at the time of his visit. There can be little doubt, however, that it was not at all rare on the Labrador shore. None were seen by me at any place, except Gannet Rock, though I think it must breed at

other points on the coast. The eggs are said by Naumann to be larger than those of the Foolish Guillemot, and the shell to be smooth, and the spots to be seldom large, &c. The largest Guillemot egg found by me was one of the present species, but in respect to the coloration I notice no particular mark by which they could be distinguished. When at Gannet Rock I unfortunately supposed that I should find this and the succeeding species equally common on the North Shore, and neglected to procure many specimens. The largest and handsomest egg procured is one of the green variety, and marked over the whole surface with lines that present very much the appearance of Chinese characters; it resembles, however, specimens of the eggs of *Uria troille*, and I see no character by which it could be distinguished from them.

Naumann gives, as one of the distinguishing features of the eggs of this bird, a peculiarly fine spotting or dotting, which gives the whole egg, at a short distance, the appearance of being uniformly dark colored. I saw no eggs at Gannet Rock that presented this peculiarity, but in the collection of the Smithsonian Institution there are eggs from California of another species, which are so marked. The species to which these eggs belong is as yet doubtful. Among the thousands of eggs of *U. troille* seen by me at Labrador, not one presented this peculiarity.

Four eggs measured: 79 x 47 mill.—75x48—70 x 46—80 x 50.

Uria lomvia,* Linn. Every available spot on the sides of Gannet Rock, not already occupied by the Gannets or Kittiwakes, had been taken possession of by the three last-mentioned species of Guillemots and the Razor-billed Auks; their comparative numbers were about three of *U. troille* to two of *U. lomvia* and one of *U. Ringvia*, and about one Auk to fifty Guillemots. I noticed nothing in the habits of these birds not already well known.

According to Naumann, the eggs of *U. lomvia* resemble a turkey's in form: though their shape is generally more ovate quently larger and less numerous, I have not been able to find any character by which they can certainly be distinguished. I have eggs, particularly of *U. ringvia*, that present these peculiarities as strikingly as any of the present species.

Four specimens measured as follows: 79 x 47 mill.—75 x 48—70 x 48—70 x 45.

ARTICLE XVII.—*List of Recent Land and Fresh-water Shells collected around Lakes Superior and Huron in* 1859–60. By Mr. Robert Bell, Assistant to Alexander Murray, Esq., Geological Survey of Canada.

(*For the "Canadian Naturalist."*)

TERRESTRIAL GASTEROPODA.

1. *Helix alternata*, Say. North shore of Lake Huron; Manitoulin Islands and the smaller islands between them and the main land; S. W. side of Georgian Bay. On a small island near Lacloche Island about a pint of these shells was collected in the space of two yards.
2. " *albolabris*, Say. Keweenaw Point; Grand Island; north shore of L. Huron; Manitonlin Islands; S. W. side of Georgian Bay.
3. " *monodon*, Raskett. Grand Island; E. shore of L. Superior; Grand Manitoulin Island; S. W. side of Georgian Bay; Sarnia.
4. " *tridentata*, Say. S. W. side of Georgian Bay.
5. " *concava*, Say. Rabbit Island; Sarnia.
6. " *multilineata*, Say. Abundant on swampy ground at Sarnia.
7. " *aborea*, Say. East side of L. Superior; Sault Ste. Marie; N. side of L. Huron; Manitoulin Islands; S. W. side of Georgian Bay.
8. " *striatella*, Anthony. East shore of L. Superior and north of L. Huron; Grand Manitoulin Island.
9. " *lineata*, Say. East shore of L. Superior; Sault Ste. Marie; Bruce Mines; Mississaugi River; Grand Manitoulin Island.
10. " *labyrinthica*, Say. Batch-ah-wah-nah Bay; Sault Ste. Marie; Mississaugi River; Grand Manitoulin Island.
11. " *chersina*, Say. Bruce Mines.
12. " *fuliginosa*, Griff. S. W. side of Georgian Bay; Sarnia.
13. *Succinea ovalis*, Gould. Tequamenen River (near Whitefish Point); Mississaugi River; Grand Manitoulin Island; Sarnia.
14. " *avara*, Say. Manitouwaning Bay.
15. *Bulimus harpa*, Say. Bruce Mines.
16. *Vertigo* ——. Various localities on the East side of L. Superior.

FRESH-WATER GASTEROPODA.

1. *Physa heterostropha*, Say. Numerous localities on the south side of L. Superior; Goulais River; Sugar Island; Manitouwaning Bay; White Cloud Island; Owen Sound; Sarnia.
2. " *elongata*, Say. Township of Nottawasaga.
3. *Limnœa stagnalis*, Lam. L'Anse; Grand Marais; Grand Island; Sarnia.

4. *Limnæa umbrosa*, Say. Manitouwaning; Lacloche Island; Owen Sound; Sarnia.
5. " *umbilicata*, Say. Manitouwaning.
6. " *caperata*, Say. Tequamenen River; Batch-ah-wah-nah Bay.
7. " *modicella*, Say. Sarnia.
8. *Planorbis trivolvis*, Say. Sousonwagami Creek (S. side L. Superior); Sarnia.
9. " *campanulatus*, Say. Lacloche Island; Manitouwaning; Owen Sound; Small lake at Cape Rich; Sarnia.
10. " *bicarinatus*, Say. Tequamenen River; Batch-ah-wah-nah River; Lacloche Island; Manitouwaning; Sarnia.
11. " *armigerus*, Say. Bruce Mines; Manitouwaning.
12. " *parvus*, Say. Sousonwagami Creek.
13. *Amnicola porata*, Say. Sousonwagami Creek; Owen Sound.
14. *Valvata tricarinata*, Say. Sousonwagami Creek, Owen Sound.
15. " *humeralis*, Say. Owen Sound.
16. *Paludina decisa*, Say. Tequamenen River; Goulais River; Batch-ah-wah-nah River; Owen Sound; Sarnia.
17. *Melania Niagarensis*, Lea. Tequamenen River; Batch-ah-wah-nah Bay, a large coarse variety; common along the shore of Georgian Bay from Cabot's Head to Collingwood.
18. " *acuta*, Lea. Abundant in St. Mary's River below the Sault.

FRESH-WATER LAMELLIBRANCHIATA.

1. *Unio complanatus*, Lea. Sousonwagami Creek; Tequamenen River; Batch-ah-wah-nah Bay; Goulais River; Mississaugi River; Lacloche Island.
2. " *radiatus*, Lam. Sousonwagami Creek; Batch-ah-wah-nah Bay; Goulais River; Sugar Island; Mississaugi River; Lacloche Island.
3. " *ventricosus*, Barnes. Mississaugi River, very abundant.
4. " *rectus*, Lam. Mississaugi River.
5. " *ellipsis*, Lea. Mississaugi River.
6. *Margaritana rugosa*, Barnes. Mississaugi River.
7. " *marginata*, Lea. Mississaugi River.
8. *Anodonta cygnea*, Linn. Sousonwagami Creek; Lacloche Island.
9. " *subcylindraca*, Lea. Batch-ah-wah-nah Bay; Goulais River; Sousonwagami Creek.
10. " *Benedictiana*, Lea. Sousonwagami Creek; Grand Marais; Batch-ah-wah-nah Bay; Sugar Island; Lacloche Island.
11. " *fragilis*, Lam. Sousonwagami Creek.
12. " . A species like *A. implicata*, Say, Batch-ah-wah-nah Bay.
13. *Cyclas similis*, Say. Owen Sound.

14. *Cyclas partumeia?* Say. Amagoos Creek (Batch-ah-wah-nah Bay); Tequamenen River.
15. *Cyclas*——. A very small species was found in great numbers in the stomachs of whitefish at Marquette in the beginning of July.
16. *Psidium dubium?* Say. Tequamenen River.

ARTICLE XVIII.—*Catalogue of Birds collected and observed around Lakes Superior and Huron in* 1860. By Mr. ROBERT BELL, Assistant to Alexander Murray, Esq., Geological Survey of Canada.

(*From the Report of the Geological Survey for* 1860.)

1. *Haliætus leucocephalus*, (L.) Bald-headed Eagle. On Sugar Island I met with an Indian having in his possession an old female and two young ones shot on the 12th of June. The bodies of the young birds were nearly as large as that of the parent, but almost unfledged. The nest from which the Indian obtained them was on a large dead poplar-tree, standing on low wet ground, near the water. Bald-headed eagles were frequently seen during the summer, often in the act of robbing the industrious fish hawks of their prey.
2. *Buteo borealis*, (Gmel.) Hen Hawk. South shore of Lake Superior and north of Lake Huron; rare.
3. *B. Pennsylvanicus?* (Wils.) Broad-winged Buzzard. A specimen which appeared to be of this species was shot in Batch-ah-wah-nah Bay, 15th August, and another in the township of Torontorus, 4th September.
4. *Pandion haliætus*, (L.) Fish Hawk or Osprey. Common around Lake Superior.
5. *Falco columbarius*, (L.) Pigeon Hawk. South side of Lake Superior; June.
6. *F. sparverius*, (L.) Sparrow Hawk. Very common on both sides of Lake Superior, and on the north side of Lake Huron, especially about bold rocky places, till the first week in October.
7. *Astur fuscus*, (Gmel.) Slate-coloured Hawk. Common on the south side of Lake Superior.
8. *A. Cooperi?* (Bonap.) Blue-winged Hawk. One seen at the Pictured Rocks in June.
9. *Circus cyaneus*, (L.) Marsh Harrier. Seen at Portlock Harbour, 15th September; Walker's River, (opposite Campment D'Ours,) 11th September; Mississaugi, 22nd September; La Cloche Island, 4th October.

10. *Syrnium nebulosum*, (L.) Barred Owl. Campment D'Ours, begining of September.

11. *Surnia nyctea*, (L.) Snowy Owl. I was informed by a good authority that this owl has been seen on Manitoulin Island.

12. *Bubo Virginianus*, (Gmel.) Great Horned Owl. Seen and heard at the mouth of Root River, 7th September. Mr. Murray informs me that he has killed two of these owls on the Meganitouwau River.

13. *B. asio*? (L.) Little Screech Owl. One seen on Kee-wee-naw Point.

14. *Caprimulgus vociferus*, (Wils.) Whip-poor-will. Mouth of Root River, 6th and 7th September; near Campment D'Ours, 9th September.

15. *Chordeiles Virginianus*, (Briss.) Night Hawk. Common along the south side of Lake Superior and the St. Mary's River. A nest with an almost full grown young one and an egg, on which the parent bird was still sitting, was found at Point aux Pius, 23rd July.

16. *Hirundo bicolor*, (Vieill.) White-bellied Swallow. Numerous on the south shore of Lake Superior, especially about the mouths of rivers.

17. *H. fulva*, (Vieill.) Cliff Swallow. Pictured Rocks, Grand Island, Gorlais Bay, Namainse.*

18. *Muscicapa tyrannus*, (L.) Tyrant Flycatcher or King Bird. South side of Lake Superior and north of Lake Huron. A nest of this bird in an old shed at the Sault Ste. Marie contained four eggs on the 20th of July.

19. *Sylvicola maculosa*, (Lath.) Black and Yellow Warbler. South side of Lake Superior; does not appear to be common. A male was shot near Iroquois Point, 15th June.

20. *Parus atricapillus*, (L.) Black Cap Titmouse. Abundant on both sides of Lake Superior and north side of Lake Huron.

21. *Dolichonyx oryzivora*? (L.) Rice Bird. Observed at Two-Heart River, 19th June; Sousonwagami Creek, 9th July.

22. *Sialia Wilsonii*, (Swainson.) Common Blue Bird or Blue Robin. Numbers at Little Current on the 7th of October.

23. *Turdus migratorius*, (L.) Common Robin. On the south and east shores of Lake Superior, at the Sault Ste. Marie, and various places on the north shore of Lake Huron. On the 6th of October great numbers of robins were congregating on La Cloche Island evidently preparing to start for the south.

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* The name of this promontory is generally spelled Mamainse, which is incorrect. The word Namainse means Little Sturgeon.

24. *Turdus solitarius*, (Wils.) Hermit Thrush. One of these birds was shot at Penetanguishene by Mr. Murray.
25. *Troglodytes hyemalis*, (Vieil.) Winter Wren. Occasionally seen in the bush on both the south and east sides of Lake Superior.
26. *Anthus ludovicianus*, (Lich.) American Pipit or Titlark. In small flocks at the Sault Ste. Marie in the begining of September, and on St. Joseph's Island in the middle of the same month.
27. *Emberiza Canadensis*, (Lath.) Canada Bunting. One specimen shot near Iroquois Point, 15th June.
28. *Niphœa hyemalis*, (L.) Common Snow Bird. Around both lakes.
29. *Carduelis tristis*, (L.) Common Yellow Bird or Goldfinch. Sault Ste. Marie and its neighbourhood.
30. *Fringilla melodia*, (Wils.) Song Sparrow. Numerous along the south shore of Lake Superior, and at the Sault Ste. Marie.
31. *Erythrospisa purpurea*, (Gmel.) Purple Finch. One specimen shot at the Sault Ste. Marie, 1st September.
32. *Quiscalus ferrugineus*, (Lath.) Rusty Grackle. Mouth of Mississaugi River, 24th September.
33. *Corvus corax*, (L.) Raven. Numerous at Grand Island near the end of June; sometimes seen on the east side of Lake Superior, July and August; La Cloche Island, 3rd October.
34. *C. Americanus*, (Aud.) Common Crow. Abundant around both lakes; a large flock seen at Hilton, (St. Joseph's Island,) 12th September.
35. *Garrulus Canadensis*, (L.) Canada Jay or Moose Bird. Abundant around both lakes. It is a little remarkable that this bird although so common in fall and winter is scarcely ever seen till after the first frosts.
36. *G. cristatus*, (L.) Blue Jay. Both sides of Lake Superior, Portlock Harbour, Manitoulin Island.
37. *Orpheus felivox*, (Swainson.) Cat Bird. Observed on the Batch-ah-wah-nah River, middle of August.
38. *Bombycilla Carolinensis*, (Briss.) Cedar Bird. Common around both Lakes Superior and Huron. A nest with three fully fledged young ones in it was found at the head of Batch-ah-wah-nah Bay, 19th August.
39. *B. garrula*, (Bonap.) Bohemian Chatterer. Sousonwagami Creek, (south side Lake Superior), 9th July; Sault Ste. Marie, 30th August.
40. *Sitta Canadensis*, (L.) Red-bellied Nuthatch. Occasionally seen on the south and east shores of Lake Superior in June, July and August.
41. *Trochilus colubris*, (L.) Humming Bird. Sault Ste. Marie, 20th July.

42. *Alcedo alcyon*, (L.) King Fisher. Abundant everywhere around both lakes, and along the creeks and rivers entering them.

43. *Picus pileatus*, (L.) Pileated Woodpecker. East shore of Lake Superior, Bruce Mines, La Cloche and Manitoulin Islands.

44. *P. erythrocephalus*, (L.) Red-headed Woodpecker. Mr. Ironside informs me that he has seen this bird at Manitouwaning.

45. *P. villosus*, (L.) Hairy Woodpecker. Around both lakes.

46. *P. auratus*, (L.) Highholder or Golden-winged Woodpecker. Common on the south and east sides of Lake Superior, and north side of Lake Huron, particularly near settlements.

47. *Coccyzus erythrapothalmus*, (Wils.) Black-billed Cuckoo, or "Chick-ko-ko." One shot near Grand Island, 25th June.

48. *Ectopistes migratoria*, (L.) Passenger Pigeon. Small flocks and single birds were met with around both lakes during the whole summer. The largest flocks were seen at Grand Island on the 23rd and 24th of June.

49. *E. Carolineus?* (L.) Carolina Long-tailed Dove. A pair of doves supposed to be of this species, was seen by our party on the east side of Lake Superior. Mr. Murray informs me that he has shot them on the north side of Lake Huron.

50. *Tetrao umbellus*, (L.) Ruffed Grouse. Around both lakes. Rather abundant in many places on the north side of Lake Huron.

51. *T. Canadensis*, (L.) Canada Grouse or "Spruce Partridge." Everywhere on the Canadian side of the lakes, but not common; rare on the south side of Lake Superior.

52. *T. rupestris*, (Leuh.) Rock Ptarmigan. Said to be found on the north side of Lake Superior in winter.

53. *Ardea Herodias*, (L.) Great Blue Heron. Portlock River, 15th September; Mississaugi Marsh, 22nd September.

54. *A. lentiginosa*, (Swainson.) American Bittern. Common on the south side of Lake Superior and north of Lake Huron. A nest with five unfledged young ones, about the size of pigeons, was found near Marquette on the 20th of June. A specimen was shot near La Cloche as late as the 27th of September.

55. *A. exilis*, (Wils.) Little Bittern. Several specimens shot on the south side of Lake Superior, where it is found in almost every marsh. Mr. Murrray shot one some years ago on the Meganitouwan River.

56. *Scolopax Wilsonii*, (Temm.) Snipe. Several brace shot at Mississaugi and La Cloche in the latter part of September.

57. *Microptera Americana*, (Aud.) American Woodcock. A single bird shot at L'Anse, 2nd July. Numerous at the Sault Ste. Marie and Mississaugi, in August and September.

58. *Choradrius marmoratus*, (Wayler.) American Golden Plover. A specimen, in summer plumage, was shot at the mouth of the Mississaugi, 24th September. Very numerous about Little Current and La Cloche Island in the beginning of October, some of them in winter plumage.

59. *Tringa arenaria*, (Aud.) Wandering Sandpiper. A number of specimens shot at the mouth of the Mississaugi, 24th September.

60. *T. semipalmata*. (Wils.) Semipalmated Sandpiper. Three specimens shot near the mouth of Batch-ah-wah-nah River, 11th August.

61. *Ortygometra Carolinus*, (L.) Sora Rail. Sault Ste. Marie and La Cloche. At the former place a male was shot, 30th August.

62. *Fulica Americana*, (Gmel.) American Coot. Mr. Murray has shot this bird at Lake Nipissing and Whitefish Lake.

63. *Podiceps Carolinensis*, (Lath.) Red-billed Dobchick or "Hell Diver." Abundant on the north side of Lake Huron after the middle of September.

64. *Colymbus glacialis*, (L.) Loon or Great Northern Diver. Common on both Lakes. Fishermen on both sides of Lake Superior set what they term "pound nets" for all kinds of fish. Loons allured by the fish at the extremities of these circular enclosures frequently alight inside of them. After gorging themselves they are unable, from want of room to start, to rise over the top of the net which is generally four feet above the water. When thus imprisoned they are easily captured alive; in this way we obtained two fine specimens.

65. *Larus argentatus*, (Brunn.) Silvery Gull. Abundant on both lakes. Numbers of these gulls were constantly hovering over the jumbling water at the foot of the Sault Ste. Marie. Half-fledged young ones were seen on projecting shelves of sandstone at the Pictured Rocks, 12th July.

66. *Sterna hirundo?* (L.) Common Tern. Tern supposed to be of this species have been seen at Little Current, and shot by Mr. Murray at the mouth of the French River.

67. *Mergus serrator*, (L.) Red-breasted Merganser. Numerous along the shores of both lakes during the whole season. They were seen in considerable flocks about St. Joseph's Island in the middle of September. Very young birds were met with near the end of August. The members of different broods varied much in size at the same season.

68. *Anser Canadensis*, (L.) Canada Goose. In spring as the wild geese are going northward many of them stop for a few days at the mouths of the numerous rivers and creeks entering the north side of Lake Huron.

69. *Fuligula fusca*, (L.) Velvet Duck. Common in the neighbourhood of La Cloche Island after the 2nd of October ; said to be common along the whole north shore in October.

70. *F. clangula*, (L.) Golden-eyed Duck. St. Joseph's Island and Portlock Harbour in the middle of September.

71. *F. albeola*, (L.) Buffle-headed Duck. One specimen shot on the Batch-ah-wah-nah River, 10th August. Numbers of these little ducks are said to pass the winter at the Little Current, where the water remains open the whole year.

72. *Anas Boschas*, (L.) Mallard or Grey Duck. In marshes, &c. On the south and east sides of Lake Superior and north side of Lake Huron, from the middle of June till the beginning of October.

73. *A. sponsa*, (L.) Wood or Summer Duck. Everywhere with the last species, but rather more frequently met with. The first drake in full plumage was shot in Mississaugi Marsh on the 22nd of September.

74. *A. obscura*, (Gmel.) Dusky or Black Duck. Occasionally met with in marshes on the east side of Lake Superior and north of Lake Huron, from the middle of August till the beginning of October.

75. *A. Carolinensis*, (Steph.) Green-winged Teal. Batch-ah-wah-nah River, 9th August; Walker's River, Portlock Harbour and Mississaugi Marsh, during September. Mr. Murray has shot both the green and blue-winged teal at Lake Nipissing.

76. *A. discors*, (L.) Blue-winged Teal. Almost always found in company with the last species on the north shore of Lake Huron.

77. *A. acuta*, (L.) Pin-tail Duck. Mr. Murray has shot these ducks on Lake Nipissing and the Wanapitie River.

ARTICLE XIX.—*On the Flora of Hamilton and its vicinity.* By JUDGE LOGIE.

(Read to the Botanical Society of Canada; Kingston, 28th March, 1861.)

There are probably few places in Canada where the study of Botany can be prosecuted with greater advantage than in the neighbourhood of Hamilton, or where the botanist will be more amply rewarded for his labours, by the number and variety of plants he will be able to collect.

The climate at the head of Lake Ontario, and particularly of the strip of land lying between the high table land or mountain as it is called, in rear of the city of Hamilton, and extending from the Niagara River round the head of the lake as far as Wellington Square, is milder than the climate of most other parts of the Province. The peach and some of the other more tender kinds of fruit, grow and thrive there, and many trees and plants not to be found in the colder parts of the Province are indigenous. Among these I may mention the black walnut, (*Juglans nigra*,) a large and handsome tree. Few of a large size are now to be found in the neighbourhood of Hamilton, though in a smaller form it is common; it is found also in the low rich lands of some of the western townships, but does not, so far as I can learn, extend to the east much beyond Hamilton. The tulip tree, (*Liriodendron tulipifera*,) is also found in several places in the neighbourhood of Hamilton: there are two large trees near the Railway Station, and last summer I found a very large tree having a diameter of nearly five feet, in the township of Glanford, some miles to the south of Hamilton. I have not heard of its being found in Canada, except near Hamilton and towards the Niagara River. The American plane tree or button wood, (*Platanus occidentalis*,) is said to be the largest North American tree except the Wellingtonia gigantea of California; none of those that I have seen, however, are so large as the tulip tree I have mentioned, or the large pine and walnut trees I have seen. The sweet chestnut, (*Castanea vesca*,) is very abundant, particularly on the hill sides in the neighbourhood of Ancaster, some miles to the west of Hamilton. The flowering dogwood (*Cornus florida*,) is common in the same locality, and in various other places. The Sassafras officinale is also common in the neighbourhood of Ancaster, in East Flamborough, on Prince's Island, and other places. In addition to

these we have most of the trees common in other parts of Canada.

Among the smaller plants and flowers found in the neighbourhood of Hamilton, I will briefly enumerate some of those most abundant in the different localities near the city. In the spring, besides the flowers common everywhere, such as the Hepatica triloba, Trillium erectum, Aquilegia Canadensis, Arum triphyllum, and some others, I have found growing on the sides of the mountain in great numbers Claytonia Virginica, Asarum Canadense, Erythronium Americanum, Sanguinaria Canadensis, Hydrophyllum Virginicum, Dicentra cucullaria, and Dicentra Canadensis, also several species of Cruciferæ, such as Cardamine rhomboidea, Cardamine Virginica, Dentaria laciniata, and Dentaria diphylla. On the other side of Burlington Bay, I found early in the spring Symplocarpus fætida, several species of Anemone, and later in the season several species of Pyrola, Lobelia spicata, Lobelia syphilitica, Ceanothus Americanus, several species of Vaccinium, also several species of Gerardia.

On Prince's Island, (which however is not an island,) Gillenia trifoliata and Diervilla trifida are very common. I have also found there Sisyrinchium officinale, Collinsonia Canadensis, Polygala Senega, Polygala Nuttallii, Hypoxis erecta, Cypripedium pubescens, several species of Platanthera, Gentiana crinita, Apios tuberosa, two species of Lespideza, and several species of Gerardia.

On the sands of Burlington Beach, Polanisia graveolens and Datura Stramonium are to be found in abundance, and in the waters of Burlington Bay at the beach, besides the Nymphæa odorata and Nuphar advena, (the white and yellow water lilies,) Sagittaria variabilis, Ranunculus aquatilis, and several species of Potamogeton are common. Zizania aquatica or wild rice, Pontederia cordata and Nesæa verticillata are also found.

On the shores of Lake Medad, a small lake about 10 miles from Hamilton, and in a sphagnous bog near Milgrove, I found Sarracenia purpurea, (the pitcher plant,) Calypso borealis, Cypripedium spectabile, Pogonia ophioglossoides, Moneses uniflora, Dalibarda repens, Calla palustris, Coptis trifolia, Linnæa borealis, Ledum latifolium, Cornus Canadensis, and some others.

[Judge Logie submitted a systematic list of the Flora of Hamilton, accompanied by a very large collection of preserved specimens, which were most beautifully prepared, and excited much

interest among the members. His list will be printed at length, with special localities, &c., for the various species, in the Annals of the Botanical Society, part II.]

ARTICLE XX.—*The Great Comet of* 1861.

(From advanced sheets of Silliman's Journal, Sept. 1861.)

The suddenness of the apparition of the comet in northern latitudes was one of the most impressive of its characteristics. On the 2d of July after the twilight had disappeared, the head, to the naked eye, was much brighter than a star of the first magnitude, if only the effective impression be taken into account, although as to intensity it was far inferior to α Lyræ, or even to α Ursæ Majoris. I should describe the head as nearly equal in brightness to that of the great comet of 1858 between the 30th of September and the 5th of October; it should be considered, however, that the present comet was better situated, from its higher position above the horizon at the end of twilight.

The aspect of the tail suggested a resemblance to the comet of March, 1843. It was a narrow, straight ray, projected to a distance of one hundred and six degrees (106°) from the nucleus, being easily distinguishable quite up to the borders of the milky way. The boundaries for the most part were well defined and easily traced among the stars. It was not until after two or three hours of observation, that I could gain a clear comprehension of the structure of the tail or tails as they presented themselves to the naked eye and through a small opera-glass. It was then evident that a diffuse, dim light with very uncertain outlines, apparently composed of hazy filaments, swept off in a strong curve towards the stars in the tail of Ursa Major—the southern edge directed as low as towards Mizar. This was evidently a broad curved tail, intersected on its curved side at the distance of a few degrees from the nucleus by the long straight ray which at the first glance, from its greatly superior brightness, seemed alone to constitute the tail. The two were in fact counterparts of the principal tail and the supplementary rays of the great comet of 1858, with this remarkable difference, that in the latter the straight rays were so far inferior in brightness to the curved tail as to have been recognized at only three observatories, those of Poulkova, Göttingen, and Cambridge, U. S.—while with the

present comet, the predominating feature was the straight ray to which the curved tail seemed scarcely more than a wisp-like appendage.

On further scrutiny with the aid of an opera-glass, two sharply cut and very narrow dark channels, bounding the principal ray, could be traced for ten or fifteen degrees from the nucleus; while outside of them, on either side, were two additional faint rays. The whole issue of nebulous matter from the nucleus far into the tail was curiously grooved and striated. It was noticed that both the principal ray and the dark channels penetrated within the outline of the curved tail, the latter being clearly separated from the principal ray even to the naked eye by a dark cleft just above their intersection. The well-defined margin of the principal ray admitted of a very exact delineation, even as far as α Ophiuchi, 100° from its origin.

On the third, the bright rays and dark channels were traced to a distance of 40° from the nucleus, the principal ray to nearly 100°. Five or six alternations were distinguished, besides the hazy filaments constituting the curved tail. Some of the streaks could be traced quite up to the nucleus. The rays were not only separated by the dark channel parallel to their axis, but they were disconnected at intervals in the direction of their length.

On the fourth, there were two or more regions of contrary flexure on the north following margin of the ray, which, in a theoretical point of view, are of very great interest when taken in connection with the direction of the ray almost precisely in a great circle from the sun continued through the nucleus. This peculiarity presented itself still more decisively on the 5th, when the tortuous path of the ray could not be overlooked.

The very singular aspect of the northern edge of the principal ray for the first thirty or forty degrees of its course, attracted particular attention, and the charts were revised with all possible care. The sky was perfectly clear and the outlines so distinct that there could be no room for doubt as to the reality of the reflexure of the curve. Subsequently on projecting an arc of a great circle from the sun through the nucleus, it was found to lie clearly within the margin of the ray as far as a distance of thirty degrees (30°) from the nucleus, and there was still haziness beyond it almost to the distance of sixty degrees (60°). The charts on other dates indicate similar results, but the data cannot be properly

discussed without requiring more labour than can be, at present, devoted to them.

Within the last few days the principal ray in the part near the nucleus, has assumed a more regular sweep in the direction opposed to that of the diffuse tail, which now reaches nearly to the centre of Corona Borealis, scarcely changing the course of its southern limit between x and ι Bootis and ζ Coronæ Borealis from night to night.

The telescopic phenomena, though interesting, have not presented equally strongly defined features with those which characterized the great comet of 1858. We should perhaps except from this remark their structure for a day or two after their first emission from the nucleus. In this stage they were intersected by jets of luminous matter projected from the nucleus, and these limits were pretty clearly outlined.

On the 2d, portions of three were visible; the inner one showing a variety of details. In its outline and general aspect it was, like others which followed it, almost a fac simile on an enlarged scale of some of those exhibited by the great comet of 1858. They rapidly faded, or were lost in the surrounding haze and their places were filled by new ones. Latterly, two, at most, could be seen at one time. It is quite important to remark that the successive envelopes resembled their predecessors not only in their general aspect but quite closely in the details of their structure; the luminous jets not issuing at random from all points alike of the nucleus, but continuing to follow a nearly similar course at each new discharge from its surface.

The most natural inference from this would seem to be that the nucleus, if it rotates at all upon an axis, does so very slowly. Of the pendulum-like vibrations of the luminous sectors ascribed by Bessel to the comet of Halley, nothing was seen; although the opportunity of witnessing them, had they existed, was very favorable, as the sectors were well displayed.

The nucleus was throughout brilliant, and, to appearance, solid, with a diameter of from 2″ to 3″.

The disposition of the nebulosity in the part of the tail contiguous to the head was nearly uniform throughout; the axial darkness being scarcely distinguishable, excepting on one occasion, July 3d.

The following positions have been derived from comparisons with neighbouring stars.

1861.	Cambridge mean solar time.	α	δ
July 2,	$8^h\ 28^m\ 38^s$	$8^h\ 37^m\ 43^s.22$	$+62°\ 51'\ 17''.1$
3,	8 21 33	9 49 15.85	66 6 15.3
3,	10 39 52	9 56 6.58	66 16 05.1
4,	10 39 18	11 2 7.48	66 53 26.4
5,	12 9 26	11 57 9.67	66 3 22.0
6,	9 17 39	12 31 2.60	64 51 33.3
8,	10 20 5	13 21 36.05	61 46 13.7
9,	10 40 47	13 37 37.88	60 21 45.2
10,	9 39 12	13 49 26.80	59 9 34.1
12,	11 57 47	14 8 0.59	56 54 47.2
13,	9 47 55	14 13 59.24	56 5 25.7

The nucleus admitted of very precise observations; indeed it is a curious fact that it would be quite possible by means of proper comparisons with neighbouring stars, to obtain the differences of terrestrial longitudes of the principal points at which it was observed, with a degree of precision only surpassed by the more refined methods known in astronomy.

The near approach of the present comet to the earth and the sharply defined point of its nucleus, illustrates the practicability of a method of determining the solar parallax with perhaps greater exactness than can be attained by any other means. Many comets have stellar points for their nuclei, visible in the larger telescopes, which admit of as accurate comparisons with neighbouring stars as is practicable in measurements among the stars themselves. Many such have appeared within the last fifteen years. Suppose such a comet to be suitably placed so as to be observed simultaneously in different quarters of the globe, when at a distance from the earth of less than one-twentieth of the sun's distance. Under favorable circumstances it would not be hazarding too much to say, that in the course of its apparition the probable error of the solar parallax could be reduced within smaller limits than is possible by means of transits of Venus or of any other method. Such an opportunity might possibly afford an improved value of the mass of the earth.

From the above elements, the diameter of the nucleus may be variously estimated at from one hundred and fifty to three or four hundred miles. On July 2d the breadth of the head at the nucleus was 156,000 miles, the height of the inner envelope 11,500 miles, and the length of the tail about 15,000,000 miles.

The comet was seen between one and two o'clock on Sunday morning, June 30th, by Dr. Brunnow, at the Observatory of Ann

Arbor. This is the earliest authentic account of its visibility which has come to my notice. The head could not have been seen on Friday evening, although observations to that effect have been reported. The extremity of the tail, however, must have been within view for some time previous, though too faint to attract notice.

The reports current of the identity of the comet with those of 1264 and 1556 are without any foundation.

ARTICLE XXI.—*What to observe in Canadian Lichens.* By W. LAUDER LINDSAY, M.D., F.L.S., Neill Medallist of the Royal Society of Edinburgh, and Hon. Mem. Bot. Soc. of Canada.

(From Annals of the Botanical Society of Canada.)

An account was given of the importance of Lichens in the phenomena of nature, and of their applications to the wants of man, in affording food, dyes and fodder. Specimens of many of the most valuable dye species were shown, including Roccella tinctoria from Greece; a series of Umbilicariæ named by Leighton, in accordance with his Monograph; Sticta pulmonaria and dye prepared from it, from the woods around Kingston; and an interesting collection of Lichens made in the United States by Mr. A. O. Brodie, of the Ceylon Civil Service. The points brought before the Society by Dr. Lindsay were the following:

1. There are no plants so variable in character as the lichens; none in which it is consequently so difficult to decide what are species and what are varieties. In order to a comprehensive knowledge of species, it is necessary to study individuals in every condition of growth and from every possible habitat. Hence the commonest species and varieties become of value—the more so if collected in countries comparatively unexplored botanically, for lichens are no exceptions to the rule that geographical differences are attended by corresponding differences in the characters of the same plants. Every Canadian collector of lichens—however common and well known the latter may be—may therefore consider himself as contributing towards a more scientific and philosophical, because more comprehensive, knowledge of a very Protean, but interesting, group of plants.

2. If the collector make a point of gathering specimens of everything he meets which belongs to the lichen family, he will run a good chance of including some novelties, perhaps new species or varieties. This is extremely probable in a country like Canada,

seeing that it is seldom a miscellaneous collection of lichens is made in any part of Britain at all remote from the largest towns without the discovery of interesting novelties. New species are most likely to be met with among the very minute crustaceous lichens which grow on rocks or trees, and which cannot be properly studied without the aid of the microscope; among species belonging, for instance, to such genera as Lecidea, Lecanora, Graphis, Opegrapha, Calicium. It is not to be expected that the tyro should make these microscopical examinations or discoveries for himself: he will probably require the assistance of some experienced microscopist or lichenoligost.

3. The applications of lichens to the arts are daily becoming more numerous and important. New dye-lichens are being discovered in India and the East. Among specimens of the latter recently sent me from India, I have found species not hitherto known to be of any practical use. Again recently the probability has been shown, on good grounds, that a lichen—the Lecanora esculenta of Pallas—was the Manna of the Bible.

4. The colorific capability of a lichen, so far as regards a red or purple dye of the nature of orchill or cudbear, may be readily discovered by simply macerating the lichen—chopped into small fragments or pulverised according to the nature of its thallus—in a weakish solution of common hartshorn (the quantity not much covering the lichen in a vial of any sort)—that is, the "liquor ammonia" of druggists—allowing the mixture to stand a few days in a warmish part of the house, and shaking it frequently, so as to expose the mass to the action of the air. Colorific lichens of this class belong chiefly to the genera Roccella, Umbilicaria, Romelia, and Lecanora.

5. The colorific capability of a lichen, so far as regards other colors—chiefly brown and yellow—may be easily ascertained by simply boiling the lichen, chopped or pulverised as before, in a small quantity of water. Colorific lichens of this class belong chiefly to the genera Romelia, Sticta, Cetraria, &c.

6. Whether and how much mucilage or starch a lichen contains may be ascertained by the same means as last mentioned, and allowing the mixture to cool, when it will gelatinise more or less, if it contain much mucilage. Cetraria Islandica and some of the Umbilicariæ are illustrations.

7. Contributions may also be made to our knowledge of the economical applications of lichens by ascertaining whether any

and what species are, or have been, used in Canada by the native Indians to yield food, dyes, &c., noting all the particulars of such uses.

8. Lichens are very easily collected and transported; they require no sort of preparation; they may be simply allowed to dry in the open air and packed as convenient. Those growing on trees generally require the piece of bark on which they grow to be sliced off with a knife, and those on stones the piece of rock to be broken with a hammer. Both may be wrapped in paper like mineralogical specimens. In all cases the localities and dates of collection should be mentioned, and any futher information as to uses, &c., which may be known to the collector.

The Rev. Principal Leitch, the President, in drawing the proceedings to a close, congratulated the Members on the success of the Meeting, and the wide interest manifested in the Society's proceedings. This meeting differed from those previously held in regard to one circumstance—the presence, of the Lady members. Botanical researches of great value had been carried out by ladies in other countries and all Departments of Scientific knowledge had benefited by their exertions. It was gratifying, therefore, that the ladies of Kingston were not behind in this respect, and he looked forward with interest to the contributions which they would no doubt continue to make to the Society's Meetings, in imitation of the example set by Mrs. Lawson. The President concluded by giving some interesting details regarding the employment afforded by the silk culture in Judæa.

The Society then adjourned.

ARTICLE XXII.—*On the Mammals and Birds of the District of Montreal.* By Archibald Hall, M.D., L.R.C.S.E.

> "When accurate lists of the resident birds in each region, and of the "summer and winter visitors, are obtained, many highly interesting and "unexpected deductions will doubtless be made, and much theoretical "reasoning exploded."—*Fauna Boreali Americana.*
>
> *Richardson and Swainson.*

Editorial Note.

[The following paper is a portion of an extended memoir of 153 MS. pages, prepared by Prof. A. Hall, M.D., for the Natural History Society of Montreal, in 1839. It received the silver medal offered by the Society; but unfortunately for the interests of science and the reputation of the Society, was not printed.

Some years after, its printing was recommended by the Council, but nothing was done. Subsequently it was entrusted to Prof. Cassin of Philadelphia, to be used in the preparation of his work on American birds, in which it is frequently quoted with expressions of high commendation. Dr. Cassin retained the M.S. for some years, and it has only recently been returned by him. Had it been printed when written, it would have been a most important contribution to American Natural History, and would have brought to its author and to the Society a large meed of scientific reputation. Even now, after much of the work involved in its preparation has been done over again, it contains so much that is of interest in Canadian Natural History, that its publication should no longer be delayed.

The portion now presented is the introduction and the account of the mammalia; the birds, which occupy the greater part of the memoir, being reserved for a subsequent opportunity.]

Introduction.

In submitting the following pages to the Natural History Society of Montreal, a few introductory observations are requisite, as well to explain the object contemplated in the work, as to offer an explanation why the obvious intention of the Society in offering for a subject "the Zoology of the District of Montreal," could not be attained, at least by the author.

With respect to the first, the motto which has been selected for the essay, is amply explanatory, and in reality, little more has been attempted beyond that object. It was rather with this intention, than to enter into competition for a prize, that the author has bestowed his labour. The necessity of attempting to establish the migratorial ranges of the feathered tribes, is acknowledged at the present day, and it has become an important matter of speculation among zoologists; and nothing can advance this end so materially as correct lists of the resident and non-resident birds in various distantly situated localities. With the view of attempting a solution of the problem, this has been carried into effect in several places. Those of the northern, and north-eastern coasts of this continent have received a partial elucidation. Richardson has given us a tolerably correct list of those of the Saskatchewan district. Charles Lucien Buonaparte has furnished a list of those which are resident or visitors in the neighbourhood

of Philadelphia, and the splendid work of Wilson and Buonaparte supplies us with those met with in more Southern States.*

Those of Lower Canada have not yet received any attention, a desideratum which it has been the professed aim of the author to supply, how feeble soever the attempt may prove. The author by no means puts forward the following catalogue as complete—to render it as much so as possible, has been his constant care, and he has invariably preferred omitting a doubtful species altogether than to include it in the list. It requires many years of careful attention, and unceasing watching to ascertain the varied species of a district. Those which are subsequently enumerated have all been observed by the author in this district, and have been with very few exceptions described from prepared or killed specimens. This method has been preferred to giving compiled descriptions from authors; but under circumstances where a reference to a prepared specimen could not be had, the author's name from whom the description is taken is given.

With respect to the second it must be observed, that zoology embraces a most comprehensive field, and includes within its range every animated being from man to the zoophyte. A work such as this could not be completed satisfactorily within as many years as months, nine months having been the time allotted by the Society, and taking this circumstance into consideration, I construed the term more liberally, and confined myself to the mammalia and aves, leaving the remainder of the subject for subsequent work at my own convenience, if opportunity offered. Should the present essay accord with the Society's views on the subject, one step will have been gained in elucidating the Zoology

* Since the preceding has been written Prof. Cassin and Mr. Baird of Philadelphia, have bestowed great labour and pains upon this subject, and the beautiful volume " Illustration of the birds of California, Texas, Oregon, and British and Russian America," intended as a supplement to Audubon's work, has appeared, and is a proof of the industry of the former gentleman, and his devotion to this branch of natural science. The writer, in obedience to the request of the Editors, was desirous of arranging his work in accordance with the published modernized classification of the latter gentleman, but was obliged to give up the task, as he found something more to be necessary than a mere detailed list of names, besides which he has discovered that Mr. Baird in his catalogue of North American Mammals, has made no allusion whatever to the genera and species under the families of the vespertiliones and cetaceæ.

of the district of Montreal, and one of by far the greatest importance.

It was the intention of the author at the commencement of his task, to have given a general outline of the habits of the species which would come under notice. It was found, however, that such a step would render the essay far too voluminous; and as nothing could be said beyond what is contained in any ordinary work on the subject, it was deemed a superfluous repetition, and moreover foreign to the real object which he had in view.

Of the mammalia, 43 have been described as being met with in the district of Montreal, the description of 39 of which have been taken from prepared specimens, two from dead ones which had been placed in the author's way for the purpose, and two compiled. Of these the genera sorex, scalops, condylura, putorius, sciurus and mus, are the most common, and generally speaking resident in the district. The others are all more or less migratory, and range throughout all parts of the fur countries, remaining in different places a greater or less period of time, according to the plenty or scarcity of their food.

The birds are by far the more numerous, interesting and important, and amply repay the labour of their investigation. Of 200 species described, the descriptions of about 24 or 25 are compiled, and that of all the others taken from prepared or dead specimens, and where the author has had it in his power to verify the description by reference to other specimens, it has invariably been done, so that the descriptions may be relied on as correct, as far as laid in the author's power. A table is annexed, "the winter quarters," and "extreme northern migratorial range" of which are taken from a similar table in the valuable work of Richardson and Swainson's American Fauna, its other columns being filled up according to the author's observations. The months in it are given without dates, and in such cases, a date, say from 1st to 20th is to be understood. In this country it must be observed, that it is impossible to assign dates, or to give an approximation to the actual times of the arrival and departure of birds. These events depend altogether upon the temperature or state of weather at the time, and bear a ratio with it.

The district of Montreal, the locality of the subsequent list, in the Province of Lower Canada, is bounded on the west by the north-eastern boundary of the Fief Durablé or Nouvelle York, on the north side of the St. Lawrence; east by the county of St.

Maurice; south-east by the counties of Yamaska, Drummond and Sherbrooke; west and south-west by the Province of Upper Canada, the River Ottawa, and the most western limits of the Province; south by the Province Line, lat. 45° N. from St. Regis to the River Connecticut, and thence by that river to its source in the highlands, and thence by the northern boundaries of the States of New York and Vermont. The River Ottawa bounds it for 335 miles, and it is amply watered by other streams, rivers and lakes, the principal of which are the following:—

RIVERS.

N. of St. Lawrence.	*S. of St Lawrence.*
Gatineau.	Richelieu.
Lievres.	Sorel.
Petite Nation.	Yamaska and its various branches.
Riviere Blanch.	Pyke.
Riviere du Nord.	Montreal.
Mascouche.	Chateauguay and its branches.
Achigan.	Lacolle.
L'Assomption.	Magog.
Lachenaye.	Coaticook.
Berthier.	Missisquoi, part of.
Chaloupe.	St. Lawrence.
Duchesne.	Ottawa.

LAKES.

N. of St. Lawrence	*S. of St. Lawrence.*
White Fish.	Memphremagog.
Sables.	Tomepobi.
Killarney.	Missisquoi Bay.
Temiscaming.	Scaswapenepus, part of.
Lievres.	Yamaska Bay.
La Roque.	St. Louis.
Rocheblave.	Two Mountains.
Pothier.	St. Francis.
Nimicachenché.	Chaudiere.
Papineau.	Chats.
Maskinonge.	Allumets.*

Generally speaking the character of the district is low and level, with here and there a scattered mountain, which is far more apparent on the southern than on the northern shores of the St. Lawrence. The soil is that best adapted for cultivation, and it

* Bouchette's Topographical Dictionary of Lower Canada, 1831.

has been amply taken advantage of. Swamps can scarcely be said to enter into the character of the district, although there are several and rather extensive ones on the south of the St. Lawrence. The streams are, generally speaking, small, and diminish severally considerably in size towards the fall of the year, by which means a muddy alluvium presents itself, which furnishes a place of resort for the Grallatores. Dependant as this circumstance is, however, on the general temperature of the summer months, supplies of food are often rendered scarce, and consequently the visits of this class of birds are not made so frequently, nor in such considerable numbers as in the district of Quebec, where the recess of the tide presents much more favourable scenes for their operations. On the whole, therefore, it may be remarked, that the Grallatores in the district of Montreal are not constant visitors, a few stragglers only being killed from time to time, which appear to have dropped *en passant*, for the purpose of rest or refreshment. The district on the contrary, is abundantly supplied with the Accipitres, Passarinæ and Scansoriæ, the second class being especially numerous, diversifying the landscape by their varied richness of plumage, while they equally invite attention by their melody.

As connected with this subject, the author deems it proper to annex the following tables of mean temperature, compiled for the city of Montreal, which from its almost central situation in the district, may be taken as a standard for the whole. They are all deduced from observations of 15 years.

Mean Temperature of the Months.

January	14.10	July	72.09
February	19.36	August	69.58
March	29.46	September	59.90
April	43.24	October	47.56
May	58.54	November	34.87
June	68.04	December	18.56

Mean temperature of the city of Montreal, deduced from observations of 15 years.. 44.60.

The following abbreviations are used opposite the species described :—

V. S. P.—Vidi specimen preparatum.
V. S. P. et M.—Vidi specimen preparatum et mortuum.
D. C.—Descriptio compilata.
V. S. P. et V.—Vidi specimen preparatum et vivum.

CLASS MAMMALIA.

Ord. III. Carnaria.

Fam. Cheiroptera—Sub gen. Vespertilio.

Sub gen. char. Incisors $\frac{4}{6}$, canines $\frac{1\,1}{1\,1}$, molars $\frac{4\,4}{5\,5}$ or $\frac{5\,5}{6\,6} = 32$ to 36. Upper incisors separated in pairs, acuminate; anterior molars conical; posterior ones having two or three trenchant points in rows with one another. Ears lateral and distinct; nose simple; tail long, enveloped in the femoral membrane. Arms, forearms and fingers elongated, forming with the membrane which occupies their intervals, and thence extended to the tarsi of the hind legs, true wings. Thumbs short, a single joint armed with a claw; fur soft and thin; sebaceous glands under the skin of the face, differing in size and shape, according to the species.

V. pruinosus. Hoary bat of Say.

v.s.p. Length from tip of nose to tip of tail $5\frac{1}{2}$ inches; length of tail $1\frac{7}{8}$ inch; alar expanse 14 inches; superior incisors acuminate, and close to the canines; inferior incisors approximate; upper canines conical and sharp; inferior ones slightly lobed at their internal base, both prominent; molars $\frac{5}{6}$ with high conical trenchant points. Fur blackish beneath, changing to a dirty yellow, then to a black, and lastly tipped with white. Muzzle and throat dirty yellow, changing to a brown on the abdomen, and towards the axilla assuming a dirty white hue, which changes to a brownish yellow, with which the anterior inferior membrane of the wings is covered, as far as the carpus. Upper surface of interfemoral membrane like the back, and the inferior also for about $\frac{1}{4}$ next the body. Membrane entirely envelopes the tail. Toes 5, whitish, furred above; claws black and curved, extremely sharp. Head short; ears large and round, not so long as the head; tragus arcuate; nostrils naked, slightly prominent, divergent.

(Described from a specimen in the museum of the Natural History Society, Montreal.)

V. subulatus. Say's bat.

v.s.p. Length from tip of nose to tip of tail 3 inches; of tail $1\frac{1}{8}$ inch; of ears $\frac{3}{8}$ inch; alar expansee 8 inches. Upper incisors short, and close to the canines; lower ones short, bilobed internally; canines long acuminate; molars $\frac{6\,6}{6\,6}$ short, with tren-

chant points, two rows below and three above; 2nd, 4th and 6th in lower jaw largest. Fur blackish beneath, with shining brown tips; chesnut coloured on back, and paler on the abdomen; interfemoral membrane slightly hairy on both sides, with the end of the tail projecting beyond it. Hind feet long, slightly hairy, 5 dactyle; claws horn-colour and curved; wing membrane naked. Head short, flat, tips of nose and lower jaw naked; eyes almost imperceptible, placed close to the base of the ear; ears nearly as long as the head, ovate obtuse; tragus subulate; whiskers few, and almost imperceptible from their fineness.

(Described from a specimen in the museum of the Natural History Society, Montreal.)

V. noctivagans. Silver haired or Audubon's bat.
V. Auduboni. Harlam.
V. noctivagans. Annals of New York Lyceum, 1837.

V.S.P. Length from tip of nose to tip of tail 4 inches; of tail $1\frac{5}{8}$ inch; of head $\frac{5}{8}$ inch; of ears $\frac{5}{8}$ inch; alar breadth 11 inches. Fur black beneath, changing to brown, and tipped with white along the back and abdomen, white tips less frequent towards the head which is brown; cheeks, tip of nose, and sides and extremity of lower jaw almost naked; nostrils prominent; eyes visible; ears as long as the head, erect, subrotund, emarginate and revolute behind; anterior tips white and ciliate; whole ear internally sparingly covered with hair; tragus arcuate, obtuse, about $1\frac{1}{2}$ lines long; wing membrane slightly pubescent along the humerus; interfemoral membrane triangular, enveloping the whole tail except the half of the last joint, pubescent beneath, hairs in lines; superiorly the half next the body covered thickly with hairs slightly tipped with white, the hair nearly three lines long; nails crooked, horn colour, grooved beneath. A very pretty bat, rarely met with.

(Described from a specimen in the museum of the Natural History Society, Montreal.)

ORD. III. CARNARIA.

Fam. Insectivora.—Gen. Sorex.

Gen. char. Incisors $\frac{2}{2}$, canines $\frac{3}{2}\frac{3}{2}$, molars $\frac{4}{4}\frac{4}{4} = 28$ to 30. Upper incisors base-indented; molars pointed; head elongate; snout moveable; ears and eyes small; nails short and curved. Teats 6 to 8, pectoral and ventral; strong smelling sebaceous glands on each flank.

S. palustris. American marsh shrew. (Richardson.)
S. Richardsonii. Baird!

D.C. Length $5\frac{1}{2}$ inches. Fur dark coloured, soft and close, presenting a silky appearance; ash coloured below. Feet paler than the back, and a little hoary; nails whitish; tail rounded, subtetragonous, and covered with short close hairs; upper lip whiskered; muzzle naked, bilobed; eyes visible; ears imbedded in the fur. Found in the neighbourhood of swamps, feeding on insects, worms and tender roots.

S. Forsteri. Forster's shrew.
S. tetragonurus. Geoffroy & Desmartes!!
S. fodiens. Cuvier!

D.C. Length $2\frac{1}{4}$ inches. Fur greyish brown above, yellowish brown beneath; tail tetragonous, tufted at its extremity; muzzle slender, bilobed; whiskers long, composed of a few white hairs intermixed with black ones; ears as long as the fur, perceptible. More common than the former species, extending to 67° N.L. Its tiny footsteps are often seen on the snow in winter.

Genus Scalops.

Gen. char. Incisors $\frac{2}{4}$, conical teeth $\frac{3}{3}\frac{3}{3}$, molars $\frac{3}{3}\frac{3}{3} = 30$. Head long, conical, terminating in a flexible cartilaginous snout; two outer conical teeth larger than the centre one; molars bristled; external ear scarcely perceptible: feet short, 5-toed; anterior very broad, having all the phalanges except the last, united by a strong membrane; eyes very small.

S. Canadensis. Shrew mole.
S. aquaticus. Linnæus!
Talpa fusca. Pennant!
Blarina talpoides. Baird!

V.S.P. Length 7 inches. Fur brownish black, velvety, rather paler on the forehead; limbs short and concealed by the fur of the body; fore legs extended under the auditory apertures. The toes in consequence of their membranous connection, form a broad palm, admirably adapted to burrowing; tail thick, short and tapering, sparingly covered with hair; snout long and linear, projecting about $\frac{1}{2}$ inch from the incisors, naked above, pubescent below, furrowed the whole length above, and about half the distance inferiorly.

Genus Condylura.

Gen. char. Incisors $\frac{6}{4}$, canines $\frac{3\,3}{5\,5}$, molars $\frac{4\,4}{3\,3} = 40$. Six inferior incisors anomalous; two intermediate ones large, spoon-shaped; next one conical, subtriangular at the base, with a basal, exterior and interior tubercle; molars bristled, the points composed of two folds of enamel; muzzle elongate, furnished with membranous appendages surrounding the nasal apertures; ears and eyes very small; feet, toes and nails, like the shrew mole.

C. cristata. Radiated or star-nosed mole.
Sorex cristatus. Linnæus!

V.S.P. et M. Length 3 to 4 inches. Fur brown and dry looking, paler beneath; snout elongated, terminated at its extremity by a star-shaped fringe of a pale flesh colour; eyes and ears scarcely perceptible; tail $\frac{2}{3}$ the length of the body, thick, and loosely covered with stiff hairs; toes black, with strong, slightly hooked nails.

ORD. III. CARNARIA.

Fam. Carnivora.—Tribe 1. *Plantigrada.*

Genus Ursus.

Gen. char. Incisors $\frac{6}{6}$, canines $\frac{1\,1}{1\,1}$, molars $\frac{4}{4}$ to $\frac{7}{7} = 32$ to 44. False molars small, make their appearance late, and are deciduous; posterior molars very strong, with a square crown and blunt tubercles; body thick, strong-set, covered with coarse hair; ears somewhat long, slightly acuminate; toes five, with strong claws, not retractile; tail short; two mammæ pectoral, and four ventral.

U. Americanus. American black bear.

V.S.P. Length 4 to 5 feet, rarely exceeding the latter. Fur black, shining, not curled along the centre of the nose and forehead; a black line, bounded on each side on the muzzle with yellowish brown patches; nose continued on nearly the same line as the forehead, slightly arched; ears oval, small, rounded at tips; tail very short; hair of the feet enveloping the claws, and projecting beyond them.

Genus Procyon.

Gen. char. Incisors $\frac{6}{8}$, canines $\frac{1\,1}{1\,1}$, molars $\frac{6\,6}{6\,6} = 42$. Canines large and compressed; the three molars next in the series are acuminate, and the three last ones are large and tuberculate; body rather slightly made, but heavy posteriorly; tail long; 5

toes, with sharp nails not retractile; muzzle pointed; ears small; teats 6 in number, ventral.

P. lotor. The racoon.
Ursus lotor. Linnæus!

V S.P. Length $1\frac{1}{2}$ to 2 feet. Fur greyish brown, composed of long white hairs of a dirty hue, ringed with black; belly paler; cheeks on each side black; streaks of a similar colour between the eyes, extending to the forehead; tail bushy, of a dirty white colour, with six distinctly marked black rings; extremities short, particularly the hind ones; toes five, with strong nails; tail 12 inches long.

Genus Meles.

Gen. char. Incisors $\frac{6}{6}\frac{5}{6}$, canines $\frac{1}{1}\frac{1}{1}$, molars $\frac{5}{6}\frac{5}{6} = 38$. First molar is rudimentary, 2nd and 3rd acuminate, 4th cutting on its outer side, 5th disproportionately large, having on its external edge three tubercles, on its internal edge a serrated crest, and on its middle another crest, separated into two parts by a groove; on the lower jaw they present nothing remarkable; body thick; feet with five toes, and strong nails; muzzle projecting; ears short and round; eyes small; tail short, with an anal pouch containing a fætid secretion.

M. Labradoricus. American badger.
Ursus Labradoricus. Linnæus!
Taxus Labradorica. Desmarets & Geoffroy.

V.S.P. Length $1\frac{1}{2}$ to 2 feet. Fur greyish brown on sides, back and tail, and black on the abdomen and legs; two narrow white lines from the nose to the nape of the neck, these stripes are bounded by black, which fades to grey, and then to white, as it approaches the ears which are black; a greyish brown patch encloses the eyes, extending to the nose; claws long, strong, and of a dark colour; tail 5 to 6 inches long and bushy; extremities though short are strong and muscular. It differs considerably from the European species, which has a darker, coarser fur, more conspicuous demarcations on the head; larger ears tipped with white, larger head and generally larger figure. The Meles Hudsonius of Cuvier is probably the animal just described. Cuvier describes it as nearly similar to the European species. The European and American species were for a long time confounded, but a closer examination of specimens, has ascribed to each their distinctive characters.

Fam. Carnivora.—Tribe 2nd. Digitigrada.
Gen. Mustela.—Sub gen. Putorius.

Sub gen. char. Incisors $\frac{6}{6}\frac{6}{6}$, canines $\frac{1}{1}\frac{1}{1}$, molars $\frac{4}{5}\frac{4}{5}$ to $\frac{5}{6}\frac{5}{6} = 34$ to 38. Head small; ears short and round; body long and slender; legs short; toes 5; an anal follicular gland containing a rancid fætid secretion.

M. erminea. Ermine.

V.S.P. et M. Length 10 to 13 inches. Summer pelage, reddish brown, deeper on the head and nose; abdomen, interior of legs, thighs, and the whole feet yellowish white; tip of tail black. There is occasionally a slight yellow tinge on the abdomen; claws concealed by the hair; whiskers black; tail long and cylindrical, 4 to 5 inches; ears short and round circumventing the meatus auditorius.

M. vulgaris. Weasel.

V.S.P. Length of body 9 inches; of tail $2\frac{3}{4}$ inches. Summer pelage yellowish brown, deeper on head, and white on abdomen; under jaw, half of upper lip, as far as the orbit, pure white; tail coloured like the black, tipped at its extremity with blackish brown. This species has a flatter forehead, a longer nose, and a shorter tail than the ermine.

M. lutreola. Mink.
Mus vison.
Mus putorius. Gmelin & Linnæus!!

V.S.P. Length 17 inches. Colour of upper fur umber brown and glossy; of the under fur brownish grey; upper pelage paler on the head and belly, and deepening as it approaches the tail; lower jaw white, with inconstant white markings on the throat; (I have seen in several instances a broad white band stretching from the lower jaw to the breast.) Whiskers black; body long; legs short and muscular; toes 5 with strong black hooked claws; two brown coloured glands between the tuberosities of the ischium and tail secreting a very fætid matter.

Sub genus Mustela.
M. martis. Pine martin.
M. Americana. Baird!

V.S.P. Length 18 inches; tail 10 inches. Fur fulvous brown beneath, brown near the summit with black tips; that of the tail longer, coarser, and almost black. In summer the fur

loses its brilliancy, and changes to a paler orange with little lustre. The throat and breast have various inconstant markings of yellowish white; feet slightly palmated at the base of the toes; toes 5 with black hooked nails.

M. Canadensis. Pean or Fisher martin.
M. Pennantii of Erxlebein and Baird!
M. melanonyncha. Bodds!
M. piscator of various authors!

V.S.P. Length of body 23 inches; of tail 16 inches. Fur shining black at the tips, yellowish brown more inferiorly, and grey brown at base; throat, abdomen and legs, blackish brown; an inconstant white mark on breast and between the hind legs; tail long, bushy and black; ears brownish with white margins, pale anteriorly and blackish posteriorly; chin and nose tipped with brown; claws hooked and strong.

Sub genus Mephitis.

Sub gen. char. Incisors $\frac{6}{6}$, canines $\frac{1\cdot1}{1\cdot1}$, molars $\frac{4\cdot4}{5\cdot5}$. Differs from mustela in having the upper tubercular molar very large, broad and long, and the inferior carnivorous with two tubercles on its inner side; toes separated, nails long; heel a little raised in walking; feet hairy; tail long and bushy or wanting.

M. Americana. Chinche or Skunk.
Virerra mephitis of Gmelin!
Chinche of Buffon.
Enfant du diable of Charlevoix.
Mephitis mephiteca. Baird!

V.S.P. Length 10 inches; tail 7 inches, the long hair at extremity of tail nearly one-half the said length. Fur black, shining on the whole body, except on the back, where two broad white lines advance and meet over the neck. A white line also reaches from the forehead to the tip of nose. Hair of the tail long and bushy, and with the exception of the tip is black; legs comparatively short, but very muscular; claws on the fore feet very strong and hooked; toes not palmated. An anal follicle contained a very fœtid secreted fluid, which by a muscular apparatus the animal is enabled to eject to a considerable distance when pursued or in danger.

Sub genus Lutra.

Sub gen. char. Incisors $\frac{6}{6}$, canines $\frac{1\cdot1}{1\cdot1}$, molars $\frac{5\cdot5}{6\cdot6} = 38$. Three false molars on each jaw; the lower greater carnivorous

tooth with two points on its outer side; head compressed, large; tongue demi-asperate; tail long, flattened horizontally, tapering; feet palmated, nails crooked.

L. Canadensis. Otter.
L. Braziliensis of Harlam!
Mustela Hudsonica of Lacepede!
Mustela Lutra Braziliensis of Gmelin!

V.S.P. Length of body $3\frac{1}{2}$ feet; tail $1\frac{1}{2}$ feet. Fur brown or fawn colour, glossy, of two sorts, internally of waved and shining brown, with long hairs brownish and black tipped. Summer pelage almost black; winter pelage a reddish brown; chin and throat dusky white; neck and head long; ears short and approximate; snout blunt; legs short; teats ventral; on each side of anus a small aperture leading to a sac containing a fœtid secretion. An animal long confounded with the European species, but pointed out by Captain Sabine as much larger, and differing in other more essential respects.

2nd Subdivision of Carnivora.

Genus Canis.

Gen. char. Incisors $\frac{6}{6}$, canines $\frac{1}{1}$, molars $\frac{6}{7}\frac{6}{7} = 40$. Three false molars above, four below, and two tuberculous teeth behind the carnivora. The large superior carnivorous tooth has a small tubercle on its inner side; posterior portion of the inferior one altogether tuberculous; muzzle variably elongate; tongue soft; ears variably erect; fore feet 5-dactyle; hind feet 4-dactyle; teats inguinal and ventral.

C. lupus. Wolf.
Canis Occidentalis, Var. Griseo—Albus. Baird!

V.S.P. Length $5\frac{1}{2}$ feet including tail; of tail 1 foot 5 in.; of ear $3\frac{1}{2}$ inches. Fur reddish brown or pale, intermixed with white hairs. The colour of the fur, moreover, varies considerably. Tail bushy, pendant; ears erect, acuminate; legs long and very muscular; head moderately long and round; hair on the neck very long, and stands out like a fringe around the head; teats inguinal and ventral; eyes oblique, irides yellow; feet very thick; toes strong; claws long and curved.

C. fulvus. Red fox.
Vulpes fulvus, Var. fulvus. Baird!

V.S.P. Length of body 2 feet; of tail 16 inches. Summer pelage ferruginous on head, back and sides, less brilliant towards

the tail; chin whitish; throat and neck dark grey, continued along the anterior part of the belly in a narrow stripe; abdomen pale reddish; anterior part of fore, hind legs and feet black; tail blacker than body, especially at the tip, bushy; at the tip a few white hairs are discernible. Winter pelage; fur more dense and glossy, and not varying much in colour; eyes oblique, irides yellow; pupil oblong; muzzle elongate; ears erect, acuminate; claws strong, nails hooked; body denoting great agility.

C. cinereo-argentatus. Silver grey or Kit fox.
Vulpes Fulvus. Var. Argentatus. Baird!

V.S.P. Length of body about 21 inches; of tail 14 inches; height of back 13 inches. Upper lip beyond the whiskers whitish, the rest of the dorsal aspect grizzled; a brown hue predominates on the crown and occiput; sides of neck, shoulders and flanks of a dull reddish orange; lower jaw white, tinged with blackish brown towards its tip and along the edges; chest reddish orange; belly, throat and inner surface of extremities white; upper surface of the feet white; tail woolly, tapering, yellowish grey superiorly, intermixed with black and white hairs; under surface brownish orange, tipped with black.

3RD SUBDIVISION OF CARNIVORA.

Genus Felis.

Gen. char. Incisors $\frac{6}{6}$, canines $\frac{1\,1}{1\,1}$, molars $\frac{3\,3}{3\,3}$ to $\frac{4\,4}{3\,3} = 28$ to 30. Two false molars superiorly and two inferiorly. Superior, carnivorous trilobed aud carinate internally; inferior bilobed trenchant and non carinate; a small tubercular tooth above without anything to correspond to it below; head short and round; ears acuminate; fore feet 5-dactyle, hind feet 4-dactyle, with long sharp retractile claws, usually sheathed.

F. concolor. American lion, Couguar or Puma.
F. discolor of Cuvier!
F. concolor et discolor. Temminck!

V.S.P. Length from tip of nose to the tip of the tail 90 inches; of tail 30 inches; of ears 2¼ inches; space between the orbits 3½ inches; greatest height 24 inches. Pelage brownish yellow, with occasional patches of a deeper shade; back deeper coloured than the sides; belly pale red; thorax, insides of thighs and legs, a pale white; lower jaw and throat entirely white; ears white internally, blackish externally; external lobule reddish

grey; whiskers white; end of the tail black; both sexes coloured alike. The dimensions given above are taken from a specimen in the museum of the Natural History Society of Montreal.

F. Canadensis. Canada lynx; Loup cervier.
F. borealis of Temminck!
F. lynx of Linnæus!
Lynx Canadensis. Baird!

V.S.P. Length of body and tail 39 inches; of tail 4 inches. Winter pelage a grey made up of white and black hairs, of a blueish grey at the base. Summer pelage short, brown at the base, and red at the tips with brownish spots. Posterior margin of ears black, anterior white, terminated by a tuft of black hairs two inches long. From the base of the ear to the angle of the jaw the hairs are very long, and give the animal a whiskered appearance; tail first grey, terminated by black; head thick and round; ears short, erect and pricked.

3RD TRIBE OF CARNIVORA.

Amphibia.

Genus Phoca.

Gen. char. Incisors $\frac{6}{4}$ or $\frac{6}{2}$ or $\frac{4}{4}$, canines $\frac{1\,1}{1\,1}$, molars $\frac{5\,5}{5\,5}$ to $\frac{6\,6}{5\,5}$ to $\frac{6\,6}{6\,6} = 30 = 32 = 34 = 36 = 38$. Molars all trenchant or conical; feet 5 dactyle; fore feet enveloped in the body as far as the tarsus; hind feet as far as the heel; between the latter a short tail; eyes large; nostrils closing voluntarily; head round; external ears wanting; four abdominal mammæ.

P. vitulina. Common seal.
Vitulus oceani. Rond.

V.S.P. Length of body and tail 39 inches; of tail 4 inches. Fur yellowish grey, variously spotted black, darker on head and back, paler on the abdomen; extremity of snout flat and broad; posterior part of head large and round, without any bony projections; upper lip moveable, extensible, furnished with thick strong whiskers; over the eyes a few bristles similar to whiskers; fore limbs short; feet palmated; toes with thick long black nails, longer on the hind than on the fore feet.

ORD. V. RODENTIA.

Genus Sciurus.—Sub genus Sciurus.

Sub gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{5\,5}{4\,4} = 22$. Superior incisors flat and cuneiform; lower ones compressed la-

terally; molars tubercular; fore feet 4-dactyle, with a rudimentary thumb in shape of a tubercle; hind feet 5-dactyle; body and tail long; 2 pectoral and 6 ventral mammæ.

S. striatus. Ground squirrel: Chip-monk.
S. Lysteri of Ray!
S. Carolinensis of Brisson!
Tamias striatus. Baird!

V.S.P. Length of head and body 6 inches; of tail 4 inches. Incisors deep, brown and furrowed; lower ones twice as long as the upper; molars equal in size, surrounded by a thin plate of enamel, acquiring a black crust. General colour of the head and upper part of the body reddish brown, the hairs grey; within eyelids white with a black streak at each angle; on the cheek a brown line, gradually increasing in breadth, reaches to the ears, brown without, grey within; on the back 5 longitudinal black bands bordered posteriorly with red, all terminating on the rump. A white line separates the two lateral ones; abdomen and inside of the thighs pale; tail red at the base with an edging of black.

S. Hudsonius. Red squirrel.
S. vulgaris, var. E. of Erxlebein.
S. vulgaris of Linnæus.

V.S.P. Length of head and body 8 inches and 6 lines; of tail 6½ inches. Incisors strong, much compressed, convex anteriorly, deep orange coloured, nearly as long as the lower ones ridges of enamel on the molars less elevated than in the former species; distance between the orbits 7 lines; eyes large, prominent; frontal bone flat; nose obtuse; whiskers black, longer than the head; ears subrotund, pencilled at the tips. On each side of nose a light brown spot, divided by a narrow black stripe. Between the ears a beautiful bright glossy chesnut commences, and continues down the back, becoming lighter on the sides; eyelids white; throat, chest, and inside of legs, dirty white. In summer when the pelage is short, a black line, well defined, separates the abdominal white from the lateral chesnut. This stripe is lost in winter when the fur is long and thick. Fore feet 4-dactyle with the rudiment of a thumb covered by an obtuse thin nail closely applied; 3rd toe longest, 2nd next in length, 1st and 4th shortest and arise more posteriorly; claws compressed, slightly curved, chesnut coloured; scrotum in spring large and pendulous; tail

reddish brown, bushy, susceptible of a distichous arrangement with light brown tips, inferiorly black and then greyish. A great many of the lateral hairs of the tail have alternate black and brown rings, three of the former intersected by two of the latter.

S. niger. Black squirrel.

V.S.P. Length of head and body 13 inches; of tail 13 inches. Fur over the whole body black, at the base greyish black; on the cheeks and throat brownish black; tail long, hairs without down; feet hairy; claws curved and much compressed, a rudimentary thumb armed with a rounded nail closely adhering to it. A fine specimen shot spring 1838, on the Montreal mountain.

S. Carolinensis. Grey squirrel.

V.S.P. Length the same as the last, but the tail much longer and more bushy. General colour grey composed of black, brown, yellowish and white hairs. In some specimens the colour assumes a golden hue especially about the head and along the sides, all the inferior parts of a lighter hue verging to white; on the anterior part of the fore and superior parts of the hind feet, the colour changes to a red, which, however the animal may vary in its general colour, is uniform and permanent. I suspect that these two are near varieties of each other, as they are desbribed under the same name by Baird, in his catalogue of N. A. Mammals in the Museum of the Smithsonian Institute. I doubt, however, if he is correct.

Sub genus Pteromys.

Sub. gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{5}{4}\frac{5}{4} = 22$. The dental system has the generic characters of the last; head short and broad; eyes large and prominent; fore feet 4-dactyle, hind feet 5-dactyle; bony appendages to the feet supporting a furred lateral membrane serving as a parachute.

P. volucella. Flying squirrel.

Sciurus volucella of Linnæus, Gmelin, Pallas and Sabine.

V.S.P. Length of body to tail 5 inches 7 lines; of tail 4 inches; extended alar length 6 inches 3 lines; between orbits 7 lines; from occiput to nose 1 inch 3 lines. Fur on the back black internally, tipped with a very light brown, around the ears assuming a darker hue; sides of nose, abdomen, and inferior surface of the parachute white, occasionally yellowish on the abdo-

men; parachute fringed with white; tail light yellowish brown, distichous beneath, the fur dense; eyes large, black; incisors orange coloured, compressed; fur of the whole body exceedingly soft, in fact almost silky.

Genus Mus.—Sub genus Arctomys.

Sub. gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{5}{4}\frac{5}{4} = 22$. Incisors strong, anterior surface rounded; molars with ridges and blunt tubercles; head large; eyes large; no cheek pouches; ears short; body thick and heavy; paws strong; fore feet 4-dactyle with a rudimentary thumb; hind feet 5-dactyle; nails strong and compressed; tail short.

A. monax. Wood chuck or Ground hog.
Mus monax of Linnæus!
Glis fuscus.
Marmota Bahamensis of Brisson!
Marmota Americana of Gmelin!

V.S.P. Length of body 17 inches; of tail 8 inches. Fur long rusty brown with grey tips; face paler, of a blueish ash colour; inferiorly grey but lighter; ears short, broad, having a cropped appearance, much imbedded in the fur; tail about half the length of the body, dark brown and bushy towards the extremity.

A. empetra. Quebec marmot.
Mus empetra of Pallas!
Glis Canadensis of Erxlebein!

V.S.P. Length of body 17 to 20 inches; of tail 7 inches. Dorsal fur dark at the base, yellowish in the middle, black near the tips, and then tipped with grey, giving the animal a hoary appearance, the grey tips disappearing towards the tail; sides of the upper lip, point of chin, cheeks and sides of neck, of a soiled reddish white colour, gradually mixing with the dark colour of the head; throat, breast, belly, fore and hind feet of a reddish orange or chestnut without mixture; hair on the tail dusky throughout, longer on the back, and darker towards the tip; tail rather flat, rounded at the tip; legs short and muscular; toes with long sharp claws, those of the four feet being longest and most curved.

Sub genus Mus.

Sub gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{3}{3}\frac{3}{3} = 16$. Molars with tubercles; ears oblong or round, nearly naked;

no ear pouches; fore feet 4-dactyle, a wart with an obtuse nail in place of a thumb; hind feet 5-dactyle; tail long, naked and scaly.

M. decumanus. Common rat.
M. sylvestris of Brisson!
M. Norvegicus of Idem!

V.S.M. Length about 9 inches; colour light brown above, greyish white beneath; tail nearly as long as the body; feet naked, dirty flesh colour; tail scaly with stiff scattered hairs.*

M. musculus. Common mouse.
M. sorex of Brisson!
M. domesticus vulgaris of Ray!

V. S. M. Length about $3\frac{1}{2}$ inches; tail about the same length. Fur dusky, grey above, ash coloured beneath; fore feet 4-dactyle, with a rudimentary thumb, clawless; hind feet 5-dactyle, naked.

M. agrarius. Common field mouse.
M. leucopus of Rafinesque!
M. sylvaticus of Forster!
Hesperomys leucopus. Baird!

V.S.P. Length of head and body 3 inches, 7 lines; of tail 2 inches, 3 lines; of ears 2 lines. Colour mixed, dusky and ferruginous, along the back, with yellowish or reddish-brown sides; cheeks lighter almost rufous; upper lip, a space on each side of the mouth, chin, throat and belly, with the inner surface of the extremities white; tail not scaly, hairs short, appressed, streaked with black along the dorsum, all the other surface white; head large and long; ears large, erect and membraneous; snout obtuse, and sparingly covered with short appressed hairs; eyes moderately large; whiskers long, black and white. Supposed by Tennant to be a variety of the European field mouse.

Sub genus Gerbillus.

Sub gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{3\,3}{3\,3} = 16$. Molars tuberculous; first with three, second with two, and third with one tubercle. Ears smaller than in the last sub genus; fore

* Another species, the *Mus rattus*, has been also killed in Montreal, undoubtedly an introduced species. The author has never seen but one specimen of it, which was a stuffed one in the possession of the Museum of McGill College, and which was trapped in a merchant's store in this city. It differs from the former only in the colour of its pelage which is blackish.

legs short, 4-dactyle and a rudimentary thumb; hind legs long; 5-dactyle with nails; tail long hairy.

G. Canadensis. Jumping mouse.
Dipus Canadensis of Davies!
Dipus Americanus of Barlow!
Mus Canadensis of Pennant!
Jaculus Hudsonius? Baird!

V.S.P. Length about the same as common mouse; head, back, and upper parts of the body reddish brown verging to yellow; under parts, as well as the insides of the extremities cream colour; a yellow streak commences below the nostrils, running along the head and superior and inferior sides of the fore limbs, and thence running along the body terminates at the thighs; tail much longer than the body; tapering, ciliated throughout, and terminating with a fine pencil of hairs; slate brown above, cream colour below; fore feet short, 4-dactyle with sharp nails; hind legs long especially from the heel to the toes, 5 dactyle; head long, lower jaw projecting beyond the upper. Ears small, oval, whiskers long.

Genus. Arvicola.

Sub genus. Fiber.

Sub gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{3}{3}\frac{3}{3}=16$. Molars with flat corners and scaly transverse zigzag lamina; Fore feet 4-dactyle with rudimentary thumbs; hind feet 5-dactyle, edged with stiff and close hairs, and in swimming like the membrane of palmated feet. Tail long, laterally compressed, granular.

F. zibethicus. Muskrat.
Castor zibethicus of Linnæus.
Mus zibethicus of Gmelin.
Ondathra zibithicus of Say.

V.S.P. Length of head and body 14 inches, of tail $8\frac{3}{4}$ inches; Fur dark umber brown in the upper part of the head, shoulders, ears and back; the down is dark grey, the tips alone being edged with brown; sides, breast, fore front of belly and cheeks of a lighter brown hue, while the chin and posterior part of the belly are ash grey; nose thick and blunt; ears small; toes full, the place of web supplied by stiff hairs, which in the hind feet, turn inwards; tail compressed laterally, thin at the edges, covered with scubs and minute stiff appressed hairs of a dusky brown colour, thicker in middle than at the root, and from the middle tapers gradually to an obtuse tip.

Sub genus Arvicola.

Sub gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{3}{3}\frac{3}{3}$=16. Molars with flat crowns and irregular plates of enamel; front toes with nails; tail round, hairy, nearly as long as the body.

A. Xanthognatus. Meadow mouse.

A. gapperi? Baird!

V.P.S. Length of head and body, $5\frac{1}{2}$ inches to 8 inches, of tail 2 inches; Incisors pale yellow exteriorly, brown ones subrotund and rather larger. Molars (upper) with three grooves; ears circular; whiskers long; fore feet 4 dactyle with rudimentary thumbs as callosities; claws small; hind feet 5-dactyle; fur in upper parts of body reddish yellow; the hairs below the yellow tips, shining grey or black; sides of head fulvous; under parts of body silvery bluish grey, darkening into blackish grey on the shoulders; a blackish brown stripe runs along the nose; tail brownish black above and white beneath.

Genus Castor.

Gen. char. Incisors $\frac{2}{2}$, canines $\frac{0}{0}$, molars $\frac{4}{4}\frac{4}{4}$= 20. Molars with flat crowns and sinerous, complicated ridges of enamel, one on the inner edge and three on the outer edge of the upper teeth; feet 5-dactyle; front toes short; hind ones longer and pulmated; tail long oval, flat and scaly; an anal pouch filled with an unctuous strong smelling secretion.

C. fiber. The Beaver.

C. Canadensis. Baird!

V.S.P. Length of head and body variable, of a fully grown one, generally 40 or 45 inches, of the tail $11\frac{1}{2}$ inches; fur dense, consisting of an inner greyish black down and a longer coarse hair of a chesnut colour more or less verging to black; nose obtuse; eyes small; ears short, thick and rounded, and susceptible of closure at the will of the animal, by a verticle apposition of the auricle; toes, fore feet free; of hind feet with large callous soles and the toes palmated; the 2d toe with two nails, the inferior of which is rounded with a cutting edge; the inner toe has a less perfect double nail, the rest have simple nails; tail linguaform, with angular oval soft scales, and hairs sparingly interspersed in their interstices; for a short distance from the body it is covered with hair.

Genus Hystrix.

Gen. char. Incisors $\frac{2}{2}$, canines none, molars $\frac{4}{4}\frac{4}{4}$ = 20. Molars with flat tops, and a ridge of enamel; head short and strong with

a thick muzzle; tongue scaly; fore feet 4-dactyle and a rudimentary thumb; hind feet 5-dactyle; body covered with spines intermixed with the hair; tail more or less long, in some foreign species prehensile.

H. dorsata. Porcupine.
H. pilosus of Catesby!
Cavia Hudsonius of Rlim!
H. Hudsonius of Brisson!
Erithrezon dorsatum of Cuvier!
Erethizon dorsatus. Baird!

V.S.P. Length of head and body 30 inches; of tail 8 inches; fur over body above and beneath blackish brown externally intermixed superiorly with white hairs and spinous quills, which are spindle-shaped and very sharp, brown, and at other times tipped with white; the upper lip is covered with a yellowish brown fur assuming a deeper tint on the forehead and sides of the head; tail brown, with a fine white hair on the tip; the hairs which cover the upper surface of the feet, curve downwards near the soles, and being worn by constant friction on the ground, form a thick marginal brush, which fits the animal for walking on the snow; eyes lateral, small and round; ears much concealed by the fur, in many instances barely perceptible. This animal forms the type of the Hystrix tribe of M. F. Cuvier. A specimen in the Museum of the Natural History Society of Montreal measures:

From the tip of the nose to the tip of the tail, 36 inches.
Length of the tail including fur............ 7 "
Distance between the eyes............... $2\frac{1}{2}$ "
Greatest height from ground including fur... 12 "

Genus Lepus.

Gen. char. Incisors $\frac{4}{2}$, canines wanting, molars $\frac{6\,6}{5\,5} = 28$. Upper incisors in pairs; two cuneiform, with a longitudinal groove anteriorly, the other two smaller; lower ones square; molars with flat crowns and transverse laminæ of enamel; ears and eyes large; fore feet 5-dactyle; hind feet 4-dactyle. Fore legs short, hind legs long; hind feet with slightly arched nails; tail short, reclinate or erect; mammæ 6 to 18; cæcum large.

L. Americanus. American hare.
L. Hudsonicus of Pallas!

V.S.P. Length 20 inches; tail including fur $2\frac{1}{2}$ inches. Sumer pelage: blackish grey at the roots, and yellowish brown at the

tips; sides of the muzzle sprinkled with white; under jaw grey; abdomen and thorax white; sides dull yellowish brown; tail white beneath and yellowish brown above. Winter pelage: blackish grey internally changing to brownish which fades to white at the tips, giving the animal a more white appearance, which is only interrupted at the margins of the ears, where the interior black of the ear becomes perceptible; the hair is twice as long in winter, as it is in summer. Weight of a full grown one about six pounds.

Ord. VII. Pachydermata.

None wild.

Ord. VIII. Ruminantia.

Genus Cervus.

Gen. char. Incisors $\frac{0}{8}$, canines $\frac{0}{0}$, or $\frac{1\,1}{0\,0}$, molars $\frac{6\,6}{6\,6} = 32$ to 44. Canines when present, bent back and compressed; head long terminated by a moveable snout or upper lip; eyes large, pupils elongate transversely; a lachrymal sinus in most species; ears large and pointed; tongue soft; horns solid and deciduous, more or less branched, wanting in females except in one species; 4 inguinal mammæ.

C. alces. Moose deer.
Alce Americanus of Jardine and Beard!

v.s.p. Pelage light brown over the shoulders; hairs internally grey changing to white tipped with brown on the shoulders, back and sides of neck; grey internally tipped with black, on the sides, upper part of the forelegs and cheeks; forehead, muzzle, internal surface of the legs, lower part of the fore and hind legs except at the tarsus, and the posterior part of the abdomen of a dirty white or grey colour; ears greyish white with a shorter fur than that on the body, the hairs here being $\frac{3}{4}$ of an inch long, while on the mane it is 4 inches, on the flanks 2 inches and gradually becomes longer as it approaches the abdomen; fur on the tail short the longest hairs being scarcely 2 inches; hairs on the upper part of the body alternately white, grey, black and brown; the shafts assuming a zigzag appearance internally and downy near their insertion into the skin. Irides hazel, pupils elongate transversely; muzzle long and very moveable projecting considerably over the lower jaw. From the intermaxillary space, hangs a tuft of black hairs $9\frac{1}{2}$ inches long, attached to a process of the skin; tarsi of the

fore and hind feet dark brown. Described from a specimen in the Museum of the Nat. History Society of Montreal, of which the following are the dimensions:

	F.	Inc.
Length from tip of snout to commencement of the tail	9	6½
do of tail, including fur........................		5½
do of ears..		9¼
do of fore legs..................................	3	0
do of hind legs..................................	3	6
do of head from occiput to tip of snout........	2	4½
Height from shoulders to ground with fur of mane.	5	9¼
Distance between the orbits........................		9

A much larger and finer specimen of this animal is in the possession of James Douglas, M.D., of Quebec, who has furnished the author with the following measurements of it. It was killed about 3 miles from that city in March, 1855.

	F.	Inc.
Length from tip of snout to tip of tail excluding the fur,	9	11
Do. of tail with fur,..................................	0	6¾
Do. from occiput to snout,..........................	3	1
Do. of fore leg along its inner surface,............	3	11½
Do. of hind leg along its inner surface,...........	4	2
Do. of ear,..	0	11¾
Do. of mane,...	0	4
Do. of the intermaxillary tuft with the fur,........	0	11
Height from shoulder to the ground including fur,.....	7	1½
Distance between the orbits,.........................	0	10¼

The white hairs of this animal are extensively used by the Indians in the fabrication of their ornaments. They possessed the knowledge of dyeing them in the most gaudy colours, long before the settlement of this country by the French, and indicated a degree of effect in using them truly astonishing, and far above what would be expected from savage tribes.

C. Virginianus. Common or Red deer.

Length from the snout to the tail 5 feet, 8½ inches; tail including fur 5 inches; from the occiput to the snout 9½ inches; ears 5¼ inches; height from the ground to the shoulders 3 feet, 2 inches. Pelage, upper and lateral parts of the body, neck, head, and ears, anterior and exterior surfaces of the extremities and tail, of a fawn colour, produced by hairs grey at the insertion,

changing to brown, then to yellow, and lastly tipped with blackish brown. Around the eyes, and sides of the nose, the fawn assumes a lighter tint; the intermaxillary space pure white, expanding into a white circular spot which covers the upper part of the throat; abdomen, and upper internal surfaces of the hind legs white; irides deep hazel; antlers incurved, branched from their internal upper surface; tail tufted, composed of white and brown hairs; back part of the knee-joints of the hind legs deep brown.

ORD. IX. CETACEÆ.

Fam. II. Ordinary whales.—*Tribe I. Delphinus.*

Genus Delphinus.

Gen. char. Teeth canine-shaped, compressed and notched on their cutting margins, from none to 200; jaws more or less elongated; spiracle luneiform, an adipose dorsal fin with an occasional longitudinal fold of skin; tail horizontally flattened and furcate.

Sub genus Delphinapterus.

Sub gen. char. Without dorsal fins; head oblique; muzzle not elongate; teeth ranging from 9 to 42 throughout.

D. Leucas. Beluga or White Grampus.
D. albicans of Fabr!

V.S.P. Length from extremity of the tail to extremity of the snout 12 feet, 5 inches; of tail 1 foot, 6 inches; breadth of the tail 2 feet, 9½ inches; length of pectoral fins 1 foot, 4 inches; distance between the eyes over the head 1 foot, 11½ inches; greatest circumference about 9 feet; head externally convex; eyes small, black, situated 5 inches above and behind the commissure of the mouth; spiracle large, luneiform, $2\frac{1}{2} \times 1\frac{1}{4}$ inches; three fins, two pectoral and a caudal or tail. There is no dorsal fin, but a slight fleshy eminence supplies its place. Colour pure white; cuticle of a mucous or gelatinous nature, nearly half an inch in thickness. The specimen from which the foregoing description is taken, was killed opposite the city of Montreal in the spring of 1836, and is at present a conspicuous object in the Museum of the Natural History Society of this city. The author has had no opportunity of examining its dental or osseous system.

END OF THE CLASS MAMMALIA AS OBSERVED IN THE DISTRICT OF MONTREAL.

ARTICLE XXIII—*On some of the Rocks and Fossils occurring near Phillipsburgh, Canada East.* By E. BILLINGS, F.G.S., Geological Survey of Canada.

1. MAGNESIAN LIMESTONE AND UNDERLYING SLATE.

In the neighbourhood of Phillipsburgh, on the eastern side of Missisquoi Bay, (which forms the northern extremity of Lake Champlain,) there is an extensive exposure of limestone occupying an area of about nine miles in length by two miles in width, arranged in a series of long irregularly parallel ridges, presenting low broken escarpments on their western faces, and gentle slopes on the eastern. The direction of these ridges is for the greater part nearly north and south, and the dip of the strata in general towards the east, at an angle of from 10° to 30°; but in some places for short distances it is from 30° to 80°. On the western side of this rocky tract, next to the bay, the strata are composed principally of magnesian limestone, often arenaceous, and in places traversed by veins and filled with irregular nodules of white quartz. Interstratified with this there are some beds of a nearly pure limestone, very compact and crystalline in texture, and usually white, or white clouded with various shades of grey. There are also occasionally to be met with, beds of limited extent, or rather lenticular masses of a hard white, or yellowish white sandstone, intercalated between the strata of limestone. It is difficult to ascertain precisely the thickness of these rocks, but it cannot be much less than 400 feet. They constitute the lower half of the series of limestones exposed in this vicinity, and along the shore of the bay south of Phillipsburgh, they rest upon a formation of hard slates, of a dark grey or blackish colour, with numerous seams of white calcareous spar. These slates dip towards the east, at an angle of from 30° to 50°, while the limestones which lie upon them have a dip of from 10° to 30° in nearly the same direction. Near the wharf, just below the old block-house, the slates constitute the lower 20 feet of the cliff, but about half a mile south, the limestone comes down to the water's edge. Further along the slates appear again at the base of the cliff, with the limestones above them. At the Province line, one mile and three quarters south of the wharf, the limestones once more reach the water, but the slates after a short interval are again exposed in the flat point on the north side of the mouth of the Rock river.

Although I have searched a good deal for fossils I have not found any either in the slates or magnesian limestones.

2. Blue thin-bedded and Nodular Limestones.

Lying to the east of the magnesian limestones, and above them, is a formation of greyish or dark blueish, sometimes almost black limestone, with some beds of white marble, of limited extent at the base. The darker coloured limestones, which constitute nearly the whole of the mass, consist of beds of from three inches to three or four feet in thickness. Usually the thicker beds seem to be composed of a number of thin layers, with irregular thin seams of shale between. Many of them thus present a nodular appearance. In this deposit there are occasional magnesian beds interstratified. Some of the strata are silicious, and where exposed to the action of the atmosphere, lose their lime, the residue forming a light red friable mass, in which the forms of the fossils are well preserved, either as casts of the interior or exterior. The thickness of these limestones has not yet been ascertained, but it is probably not less than 400 feet. The strata are a good deal disturbed by faults, and much further examination will be required before it can be determined with certainty, how often the same strata are repeated in the different ridges. On a recent visit to this locality with Sir W. E. Logan, we found in these rocks about forty species of fossils, which shew that this part of this series of limestones is the equivalent of the upper part of the Calciferous sandrock. Of these fossils I shall now proceed to give an account.

Plantæ.—Several species of fucoids occur on the surfaces of some of the strata. They resemble those of the Calciferous sandrock.

Zoophyta.—One specimen was found which resembles *Stenopora fibrosa*, and in the higher beds, an obscure fossil very like *Tetradium fibratum*. These fossils are so badly preserved that I do not consider them identified. No trace of any other coral was observed.

Echinodermata.—There are here the columns of three or four species of Crinoids. The detached plates of a Cystidean which is either *Palæocystites tenuiradiatus*, (Hall, sp.) so abundant in the Chazy limestone, or a closely allied species—is common.

Bryozoa.—In the highest beds several specimens were observed which resemble *Stromatopora rugosa*, (Hall, sp.) but it

is impossible to say positively whether or not they belong to that species. The Calciferous sandrock in some places is full of concretions, which being composed of concentric layers, present on weathered surfaces an appearance almost exactly like that of *S. rugosa*, and therefore it may be that the specimens in question have nothing organic in their character. No other indications of Bryozoa were seen.

BRACHIOPODA.—*Camerella calcifera* is the most abundant species. There are five species of *Orthis* all undescribed; one much resembles *O. parva*, (Pander,) and another is very like the small variety of *O. calligramma*, figured in SILURIA, 3rd ed., p. 53, fig. 12. All of these species occur in the limestones at Point Levi, and one *C. calcifera* is found also in the Calciferous sandrock at St. Timothy and Edwardsburgh. No other Brachiopoda were found.

LAMELLIBRANCHIATA.—No species of this order were found.

GASTEROPODA.—The most abundant species are *Maclurea matutina*, (Hall,) *Ophileta sordida*, (Hall, sp.) *O. levata* and *O. complanata*, (Vanuxem.) I am under the impression that the three latter constitute but one species. In the same beds we find numerous examples agreeing with all the figures given by Hall and Vanuxem, and it appears to me that *O. levata* is simply two or three of the inner whorls of *O. complanata;* and that *O. sordida* is the same seen in section in the rock. We traced these fossils through a thickness of 270 feet in a continuous section. They are more abundant in the upper than in the lower strata of the section. Associated with the above are *Ecculiomphalus Canadensis*, *E. intortus* and *E. spiralis ;* five species of *Pleurotomaria ;* three of *Murchisonia ;* two of *Holopea* and two of *Capulus*.* One of the species of *Holopea* appears to be *H. dilucula*, (Hall.) Both of them and also *E. Canadensis* and *E. intortus* occur in the limestone at Point Levi. These fossils abound in several ridges of limestone about a mile east of Phillipsburgh, north of the road leading to Freligsburgh. *Maclurea magna* or a closely allied species, occurs in immense numbers in several exposures of limestone five or six miles further north in

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*In my paper on the Point Levi fossils in this Journal, vol. 5, p. 301, I referred several species of this tribe to the genus *Patella*. But since then I see that Barrande places similar species in *Capulus*. "See Fauna primordiale dans la chaine cantabrique." Bul. Geo. Soc., France, 2nd series, vol. 17, p. 516.

Stanbridge. The rocks of these localities appear to be higher in the series than those near Phillipsburgh, and may represent some portion of the Chazy.

CEPHALOPODA.—*Orthoceras*, 7; *Cyrtoceras*, 3; *Nautilus*, 2. These are all undetermined but they have the aspect of the Cephalopoda of the Calciferous sandrock. Some of the Orthoceratites are slightly curved and have the septa very closely arranged.

CRUSTACEA.—*Bathyurus Saffordi*, *B. Cordai*, *Amphion Salteri* *Menocephalus globosus?* and a species of *Asaphus* are the only trilobites observed. The most abundant of these is *B. Saffordi* which is also the dominant form at Point Levi. When I described this species (this Journal Vol. 5, p. 320,) it was impossible to determine which of the several forms of pygidium so common at Point Levi belonged to the glabella to which I gave the name. But in the vicinity of Phillipsburgh there are several localities where the pygidium figured below is common, and where no other species of the genus has been found. The only glabellæ associated with it are those of *B. Saffordi*, *M. globosus*, and *A. Salteri*. Only one specimen of *B. Cordai* consisting of an imperfect glabella was collected, but at a locality where no fragments of *B. Saffordi* were observed. It seems therefore almost certain that this pygidium and glabella belong to the same species.

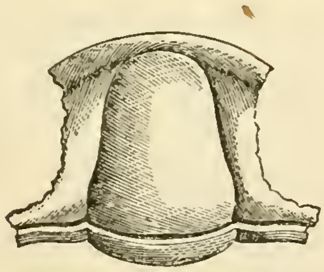

Fig. 1.

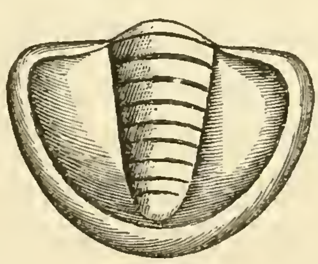

Fig. 2.

Fig. 1.—Glabella of *B. Saffordi*.
2.—Pygidium of the same.

The lateral and posterior margins of the pygidium of *B. Saffondi* are uniformly curved so as to form a regular semioval, the proportional length and breadth of which vary somewhat but in general, the former is three-fourths of the latter. The anterior angles are rounded. The axis is convex, conical, or subcylindrical, and varying from one fourth to one third the whole width of the pygidium at the anterior margin. It has nine segments, but in most specimens the last three are very indistinctly defined. It terminates abruptly in a rounded point at one line and a half from

the posterior margin. The side lobes of the pygidium are without ribs, but a deep rounded groove runs all round at one line from the margin.

This pygidium was first discovered by Mr. Hunt at Point Levi and for several years was the only fossil known to us in the limestones of that locality. Afterwards the late John Head, Esq., and Sir W. E. Logan found other specimens of it at the same locality. This led to further researches, and at length Mr. Richardson and Mr. Bell discovered the rich fauna which has given us a clue to the Geological age of the Quebec group. At Point Levi *B. Saffordi* is the most abundant and characteristic fossil of the Limestone which I have designated, No. 2, in the paper above cited. It is common at Phillipsburgh, but not so abundant as at Point Levi.

B. Cordai.—Of this species I found one specimen on Lot No. 1 of the Township of St. Armand, in the hill west of the road to Phillipsburgh, close to the Province line. On comparing this species with *B. conicus* from the Calciferous sandrock at St. Timothy, I am strongly inclined to consider them identical, the only difference being that the surface of the latter is tubercled and of the former smooth.

Menocephalus globosus ? Two ill-preserved glabellæ were found which resemble this species.

On comparing the whole collection of the Phillipsburgh fossils with those at Point Levi, the general aspect is the same, and I believe that at least one half of the species are common to the two localities, but owing to their state of preservation much further examination will be required to decide this question with certainty.

In the following table I shall designate the rock in which the *Dikellocephalus*, &c., occurs at Point Levi No. I, and include all the others of that locality under No. 2. The Phillipsburgh rocks I shall also divide into two groups; the magnesian limestones No. 1, and the upper blue limestones No. 2. In this arrangement I wish it to be understood that although I consider No. 2 of Phillipsburgh as the equivalent of No. 2 at Point Levi, yet the groups No. 1 of the two localities I do not identify. It is possible that they may be the same, but the question cannot be decided with certainty without fossils :—

Table showing the Fossils common to the limestones of Phillipsburgh and Point Levi.

		Phillipsburgh.		Point Levi.	
		No. 1.	No. 2.	No. 1.	No. 2
1	Camerella calcifera.............		×	×	×
2	Orthis parva ?....................		×		×
3	" "		×		×
4	" "		×		×
5	" "		×		×
6	" "		×		×
7	Holopea dilucula................		×		×
8	" "		×		×
9	Ecculiomphalus Canadensis....		×		×
10	" intortus.......		×		×
11	Bathyurus Saffordi		×		×
12	" Cordai		×		×
13	Menocephalus globosus ?		×	×	×

The above table shows that the upper limestones at Phillipsburgh must lie on the same geological horizon, very nearly, as that of limestone No. 2 of Point Lévi. I am strongly under the impression that eight or ten of the other Phillipsburgh species occur at Point Levi, but it is difficult to identify species of *Pleurotomaria* and *Orthoceras* without good specimens.

In the palæontology of New York, Prof. Hall notices 13 species as occurring in the Calciferous sandrock of that State. Of these, three are fucoids and one (*Orthoceras laqueatum*) has no locality. *Turbo obscura* and *Pleurotomaria turgida* appear to be one. With the above deductions there are only eight *Mollusca*, and of these the following occur at Phillipsburgh, *Maclurea matutina*, *Ophileta sordida*, *O. levata*, *O. complanata*, and probably *Holopea dilucula*. There are several specimens of *Orthoceras*, with the septa closely arranged as in *O. primigenium*. These species are stated to occur in the higher part of the rock, in the State of New York, and therefore it seems probable that No. 2 at Phillipsburgh represents the upper part of the Calciferous sandrock as developed in the Mohawk valley.

3. Description of some of the new species of Fossils referred to in the foregoing paper.

Genus Camerella. (Billings).

Camerella.—(Billings.) *Canadian Naturalist and Geologist*, Vol. 4, p. 301. August, 1859.

Triplesia.—(Hall.) *Twelfth Annual Report of the Regents of the University of New York*, p. 44, October or November, 1859.

In August, 1859, I published this genus in the Canadian Naturalist and Geologist and described three species under it *C. longirostra*, *C. Panderi*, and *C. Volborthi*; the latter two from the Black River and the former from the Chazy limestone. Shortly afterwards Prof. Hall proposed the name *Triplesia* for it, but he did not describe any of the internal characters. He dated his genus back to 1858, although it was not published until October or November, 1859. The twelfth Annual Report above cited, in which the genus *Triplesia* was first made public, is stated (on the cover) to have been "made to the Assembly, March 15, 1859." The only other date on the cover is "Albany, 1859." The first six pages of the report are occupied by the business matters of the Regents relating to the affairs of the University. Then follows a title-page to the paleontological portion of which the following is a copy, "*Contributions to the Palæontology of New York; being some of the results of investigations made during the years* 1855-56-57 *and* 58." At the foot of the page is the following note. "*The following notices and descriptions of new genera, with other investigations have been communicated, in part or entirely, at different times to the Albany Institute; to the Reports of the Regents of the University on the State Collections of Natural History, for the years* 1856 *and* 1858; *to the American Association for the Advancement of Science, and are already printed in the third volume of the palæontology of the State of New York.* No other date of publication is given either on the cover or title-page. The 3rd volume of Palæontology of New York was not published until 1860. Upon examining the other Reports and proceedings referred to, I am satisfied that the genus *Triplesia* was not published in 1858. At all events the date given by Prof. Hall must be regarded as doubtful and can have no authority until he shows in what work he published the genus in 1858. As to the time of the publication of the Twelfth Annual Report, the following are the facts, as nearly as I can ascertain them.

Some time previously to the 1st of July, 1859, the first 18 pages of the palæontological part were printed, and made up into a pamphlet. A copy was sent to the editors of Silliman's Journal and was noticed by them in their July number, at p. 149. I saw this notice and wrote to a friend in Albany to send me a copy. He could not get one as only a few had been made up, apparently for private distribution. The printer however gave him some loose sheets as far as page 18, which had been corrected for proof and thrown aside after the pamphlet was published. I received them in the beginning of the month of August. I afterwards, in September, received the pamphlet. At that time, i.e. in September, only 18 pages had been issued. The remainder, containing a description of *Triplesia*, must have been published some time during the Autumn of 1859. The note on page 62 could only have been written after the meeting of the American Association, in August, as it contains information that was then first made known. I feel satisfied therefore that the genus *Camerlla* was published several weeks before the genus *Triplesia*, and besides, as Prof. Hall did not notice any of the internal characters, his description can have no authority.

In the Twelfth Annual Report the reader will find several other genera thus dated.

Page 24, " Genus Nucleospira. (Hall 1857)"
" 27, " Genus Trematospira. (Hall 1857)"
" 32, " Genus Leptocoelia. (Hall 1856)"
" 35, " Genus Eatonia. (Hall 1856)"

I think naturalists have a right to ask, in what works were the descriptions of these genera published at the dates indicated ? And if they were not published at the times stated, for what purpose were these dates given ? The same questions may be put with respect to the genera *Rhynchospira*, *Tropidoleptus*, and *Rensslœria* which were first described in the same work.

The genus *Camerella* appears to belong to the family Rhynconellidæ, the species differing from the ordinary forms of *Rhynconella* by having the surface, in general, either not ribbed at all, or with only a few obscure plications not extending to the beak. The interior differs in having the dental plates of the ventral valve converging so as to form a small triangular or oval chamber of variable dimensions as in *Pentamerus*. The species known up to the present time are the following :

Potsdam Sandstone. One species undescribed discovered by Dr. Shumard in Texas.

Calciferous Sandrock. Two Species, *C. calcifera* and another large undescribed species of which I have some fragments.

Chazy Limestone. Two species, *C. longirostra* and *C. varians.* This Journal, Vol 4.

Black River. Two species. *C. Panderi* and *C. Volborthi.* This Journal, Vol. 4.

Trenton. Three species. *C. extans, C. nucleata,* and *C. cuspidata.* These three were described by Prof. Hall in Vol. 1, Pal. N. Y., under the genus *Atrypa.*

Of the ten species known in America seven occur below the Trenton Limestone. The Texas species is particularly interesting on account of its association with primordial trilobites. The following are the fossils which are found with it in the same beds. This list is copied from Barrande's elaborate memoirs on the Primordial Zone and Taconic system in the Bulletin of the Geological Society of France.* It was prepared for him by Dr. Shumard.

" *Agnostus*, very similar to *Agn. Orion.* Billings.

" *Conocephalites.*

" *Lonchocephalus* (*Bathyurus*) *armatus ?* Billings.

" *Arionellus.* Two species very distinct, of which one resembles a form that occurs in the third magnesian limestone of Missouri.

" *Discina.*—One small species.

" *Orthis Coloradoensis.* Shumard.

" ——— *Sps. indet.*"

The above list so far as it goes exhibits an association of organic types similar to that which occurs in the limestones at Point Levi. In no country in any part of the world has such an assemblage been discovered above the Primordial Zone, or at least above the very base of the Lower Silurian, and the genus *Camerella* is therefore one of the most ancient of the brachiopodous forms of life.

Camerella Calcifera, N. sp.

Description—This species varies from four to nine lines in width. The proportional length varies from a little less to a little

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* *Documents anciens et nouveaux sur la faune primordiale et le Systéme Taconique en Amerique*, par M. J. Barrande. Bul. Soc. Fr., 2nd Series, Vol. 18, p. 203.

more than the width, the difference being caused by the variable form of the front margin which is sometimes concave or nearly straight, as represented by the figures *a* and *b*, (below) while often the middle portion is either convex or projects so as to form a small rounded lobe. The ventral valve is either moderately or strongly convex; the beak pointed and slightly elevated above the hinge line, with a small area beneath it; the hinge line somewhat straight, its length about half the width of the shell; sides rounded; the front margin either concave, straight, or convex, sometimes with a small projecting lobe in the middle; the mesial sinus is usually one-third the width of the shell, evenly rounded in the bottom, and becoming obsolete before reaching the beak. The dorsal valve is more uniformly convex than the ventral; the mesial fold rounded and usually disappearing at about half the length of the shell. The surface has usually a smooth appearance, but on many specimens from ten to twenty concentric sublamellose ridges of growth are visible.

Fig. 3.

Fig. 3.—*Camerella calcifera; a*, ventral valve*; b*, dorsal; *c*, interior of ventral valve, shewing the small chamber beneath the beak.

Affinities of this species.—Camerella extans (Emmons) has the hinge line wider and the mesial lobe defined to the beak. *C. nucleata* (*Atrypa nucleus*) is most closely allied to this species, but is in general more strongly trilobed, and, according to Prof. Hall, has the beak of the ventral valve incurved over that of the dorsal. In our species it is elevated in a manner similar to that of the beak of an *Orthis*. Notwithstanding these differences these three species are all closely related and may yet be united.

It is to be borne in mind that this species varies greatly in size and in the contour of the front margin. The mesial fold on the dorsal and the sinus in the ventral valve are sometimes nearly obsolete, but in general are well developed for half the length of the shell. Out of about 100 specimens which I have examined there are three in which the sinus extends nearly to the beak, but in all the others it dies out about the middle of the shell.

Although the individuals of this species are numerous, I have not succeeded in getting a specimen with the valves united.

Locality and formation.—This species occurs in the Calciferous sandrock at St. Timothy on the St. Lawrence above Beauharnois,—in the Township of Edwardstown, between Beauharnois and Lake Champlain,—abundantly at Phillipsburgh, and also in the limestones of the Quebec group at Point Levi.

ECCULIOMPHALUS CANADENSIS, N. sp.

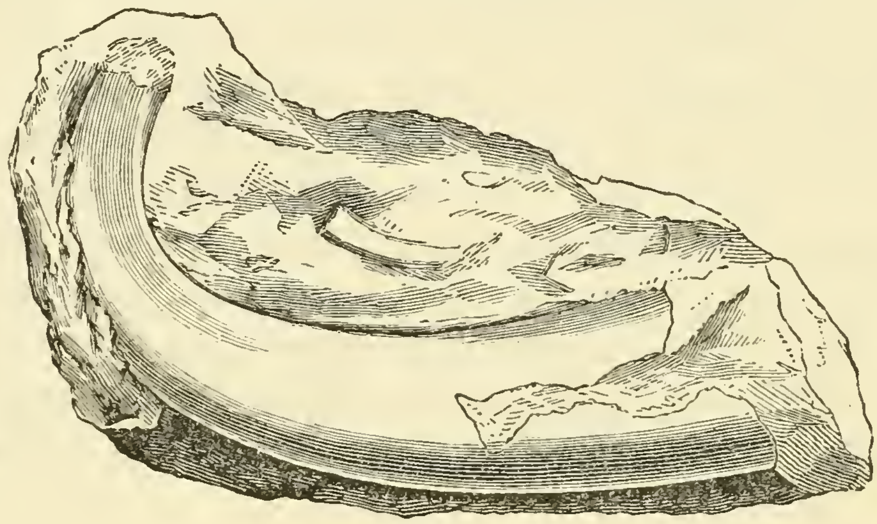

Fig. 4.

Fig. 4.—*Ecculiomphalus Canadensis.*

Description.—This species consists of a simple curved tube usually about three inches in length. The larger extremity for about two inches is nearly straight, and the cross section nearly circular. The remainder, to the point, curved so as to make half a whorl of an inch across, or a little less. In this part the tube is not cylindrical but flattened laterally. In most of the specimens the sides are more sharply rounded than the dorsal or ventral aspects. In none that I have seen is the shell preserved, so that the surface characters remain unknown. Some of the fragments shew that the shell near the smaller end is greatly thickened.

Length from two to three inches; diameter at the aperture from six to nine lines.

Locality and formation.—Ormstown, in the Seigniory of Beauharnois, and Phillipsburgh in the Calciferous sandrock. Also in the limestones of the Quebec group at Point Levi.

ECCULIOMPHALUS INTORTUS. N. SP.

Descripition.—This species consists of a simple conical tube, so coiled as to make two whorls within a circle of one inch and a half in diameter. At the aperture the cross section of the tube is nearly circular, and five lines in diameter in a specimen which

measures one inch and a half across the whole coil. The inner or apical whorl is usually about half an inch across. The remainder being not so sharply curved, completes only a second whorl at a diameter of one inch and a half. Most of the specimens that I have seen consist of only one whorl and a half, but we have some imperfect ones of two whorls. In the casts of the interior an obtuse carination is sometimes seen on one side. The surface of the shell appears to be smooth, but owing to the peculiar state of preservation of these fossils, this point cannot yet be determined with certainty.

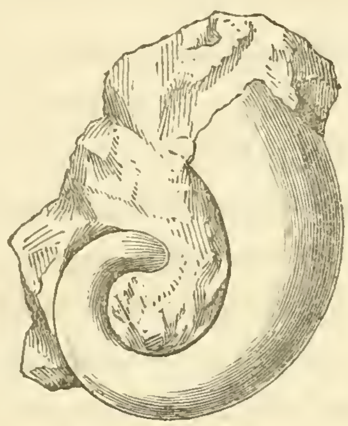

Fig. 5.

Fig. 5.—*Ecculiomphalus intortus.* A specimen imperfect at both extremities.

Locality and formation.—In the calciferous sandrock in the Township of Edwardstown and at Phillipsburgh. Also in the limestone of the Quebec group, Point Levi.

ECCULIOMPHALUS SPIRALIS. N. SP.

Description.—This species resembles a large *Pleurotomaria* with two whorls disjoined their whole length and distant from each other throughout about half an inch. The cross section of the tube is oval being somewhat flattened vertically the upper side depreseed convex and the lower obtusely carinated. The two whorls make a spiral coil from three to four inches across. The inner whorl is from one inch to one inch and a-half across. The aperture is from three-fourths of an inch to one inch wide measured in the plane of the coil and almost one third less in depth. The surface of the shell, a small portion only of which is preserved on one specimen, is marked by sharp elevated sub-imbricating transverse lines of growth about five in two lines.

The inner whorl is elevated a little above the outer forming a depressed spire.

Locality and formation.—In the upper limestone at Phillipsburgh.

AMPHION SALTERI. N. SP.

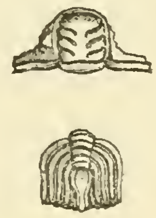

Fig. 6.

Fig. 6.—Head and tail of *Amphion Salteri.*

Description.—Head about three lines in length and five lines in width at the base. Glabella convex, oblong, one-third the width of head, with straight sides, front obtusely rounded and slightly narrower than the bease; neck furrow extending all across; three pairs of glabella furrows inclining slightly backwards; their inner extremities separated by about one-third the width of the glabella. The margin in front of the glabella is scarcely half a line in width. The fixed cheeks are separated from the glabella by a deep groove on each side. The eye appears to be opposite the second lobe of the glabella from the neck furrow and distant about three fourths of a line from the furrow which separates the cheek from the glabella. The fixed cheeks appear to be covered with small tubercles.

The pygidium has the front margin rounded and the posterior somewhat straight. The axis is conical and strongly convex with five or six segments, well defined. The pleuræ of the pygidium are five on each side and in their posterior half or two-thirds nearly parallel with the axis and then curve inwards to join the axial segments. Length of pygidium about three lines; greatest width at about one-third the length three lines at which width (nearly) it continues to the posterior margin.

Cheeks and Thorax unknown.

Affinities.—The tail of this species very closely resembles that of *A. Canadensis* but the glabella at once shews it to be distinct as all three pairs of glabellar furrows are in the sides while in *A. Canadensis* the front pair are placed in the front margin. There is no other described species to which this is closely allied.

The head and tail have not been seen in connection, but they are often found in the same slabs of stone, and as there is not associated with them any other pygidium to which the head could

be referred it seems highly probable that they belong to each other.

Locality and Formation.—Phillipsburgh, Calciferous Sandrock.

4. Grey and Red Sandstones.

On the eastern side of the limestones at Phillipsburgh there is a ridge of grey sandstone which usually weathers to a light reddish or yellowish colour. This ridge terminates about two miles north of the road to Freligsburgh. It then appears to be overlaid first by the magnesian limestone and above this the blue limestone. The immediate line of junction of the magnesian rock with the sandstone was not observed. This ridge runs in a southerly direction into Vermont. No fossils were found in it in its prolongation into Canada, but hearing that the Rev. J. B. Perry and Dr. G. M. Hall, of Swanton had discovered trilobites in it, I called upon them and they kindly accompanied me to the locality. The place is about two miles south of the Province line and one mile east of the Highgate Springs. The rock is here a deep red sandstone, the typical red sandrock formation of Vermont. We collected numerous specimens of the head of a small species of *Conocephalites.* No other fossils except a small *Theca* were observed. It thus seems clear that this rock is not the Medina sandstone but a formation somewhere near the Potsdam sandstone.

On looking over the back numbers of Sillimans Journal I find that the resemblance of this trilobite to *Conocephalites* was recognised by Prof. C. B. Adams in 1848, but he did not attach to it any importance as indicating the age of the formation. In fact the geological position of *Conocephalites* was not then generally known ; Barrande's " *Notice préliminaire*" in which the characters of the Promordial Zone were first clearly pointed out had been then only lately published (in 1846). As everything relating to the question of the age of these rocks is of interest I shall quote Prof. Adams paper in full. It seems necessary first to explain that Dr. Emmons contends that the red sandrock on the top of Snake Mountain is the Calciferous sandrock and that the slate beneath it is his Taconic slate. He says that a great fault runs through the mountain which throws the rocks down on the West side so that the top of the Utica slate lies below, or at a lower geographical level than the Calciferous.

"*On the Taconic Rocks*; by Prof. C. B. Adams.—The north part of Addison county, Vermont, possesses peculiar advantages for the study of the so-called Taconic rocks, since here they pass from a highly metamorphic to a slightly metamorphic condition and have been much less disturbed. Some of the typical Taconic rocks disappear, or more probably pass gradually into rocks of the Lower Silurian system.

"One of the most conspicuous of the rocks of this region, is a red sandrock, which Dr. Emmons regards as at or near the base of the New York system, but which overlies the Champlain Division, in the order of red sandrock, Hudson river shales, Utica slate, Trenton limestone, and La Motte limestone.

"A section was exhibited of Snake mountain, in which these rocks appear by an uplift with their relative position unaltered. The two lower formations are identified by their appropriate fossils, which occur abundantly; the Utica slate by its position and lithological characters; the Hudson river shales by the same characters, and by their upper member, which is an argillaceous limestone containing the stinted forms of *Chœtetes lycoperdon* which are usual in this the last period of the existence of the species. The red sandrock lies upon the last named rock in actual contact, with a moderate easterly dip. The upper part of this section is repeated in the line of the strike in several other localities, but one only, Buck mountain, three miles north, has sufficient elevation and steepness to exhibit the lower part of the series.

"The assertion which had been made, that there is a line of fracture high up the side of the mountain, above the Trenton limestone, was shown to be entirely unsupported by any facts. Not only is there no evidence that such a line of fracture has brought up the shales from beneath the Trenton limestone, but the fossils in the upper member of the shales prove that the present is their original relative position. But these shales are the Taconic slates of the Taconic system.

"From position, therefore, it is inferred that the red sandrock if more recent than any of the Champlain Division. Its fossils afford less demonstrative evidence. With the exception of *Fucoids* they are rare, having been been found only at Highgate, where fragments of the shields of trilobites, having some resemblance of Conocephalus, occur very abundantly, and atrypa hemispherica (?) very rarely. These fossils, especially the latter, if correctly

identified, indicate the period of the Medina sandstone and Clinton group, regarding these two rocks as belonging to one period.

"It was also shown by a section from Lake Champlain to the Green Mountains through Ferrisburgh and Monkton, that the Taconic quartz rock is probably a metamorphic equivalent of the above named red sandrock. In this section there is a gradual change in the lithological characters from the red sandrock to the quartz rock; the difference in the lithological characters, however, is only such as must have been the effect of igneous agency in the eastern part of the section, and the order of succession of the calcareous over the quartzose members is identical in both rocks. But since a small part of the section, on the opposite sides of which the change of characters is most conspicuous, is concealed by drift, the identity of the Taconic quartz rock with the Medina sandstone was not positively affirmed.

"A section from Buck Mountain through Waltham into New Haven was exhibited, which rendered it somewhat probable that the Stockbridge limestone of the Taconic system is the equivalent of the calcareous rocks which overlie the red sandrock, rather than of the lower limestones of the Champlain Division, as has been commonly supposed.

"In reply to Dr. Emmons, [an abstract of whose remarks on the Taconic system we have not received,] it was stated by Prof. Adams that he (Dr. E.) had misunderstood the description of the calcareous rock over the Hudson river shales, which was not affirmed to be the Trenton limestone, but an upper member of the Hudson River shales, as proved by the contained fossils in connection with the position. The remarks of Dr. E. being based on this misconception of the statements actually made, could not of course affect the conclusion respecting the age of the rocks of Snake mountain." *Silliman's Journal*, 2nd Series Vol. 5, p. 108.

The section at Snake Mountain has been, it appears, examined by Prof. Hitchcock and Prof. W. B. Rogers and they have both arrived at the conclusion that there is no dislocation passing through the hill, as Emmonds contends, but that there is an unbroken succession in conformable sequence of all the rocks of the New York series, from the Trenton to the Medina inclusive. On this most important section which brings Palæontology and Physical Geology into a direct antagonism with each other, the following are Prof. Roger's remarks, as they appear in the proceedings of the Boston Natural History Society, March 7, 1860.

"Mr. C. H. Hitchcock exhibited a geological map of Vermont, and explained the principal features of the complicated geology of that State.

"The two most interesting points in this connection were, that there is no foundation for what Mr. Emmons called his Taconic system, (a mixture of the Silurian and Devonian,) and that the Dorset limestone (his Stockbridge limestone) is newer than the lower Silurian, and is probably upper Silurian or Devonian.

"Prof. W.B. Rogers remarked upon the importance of the investigations referred to by Mr. Hitchcock, and spoke of the difficulty which the geologist has to encounter in attempting to ascertain the precise sequence of the rocks in a region where, as in the greater part of Vermont, perplexing structural features, metamorphic influences, and an extreme paucity of fossils combine to embarrass his enquiries. It is not therefore matter of surprise that, in spite of repeated explorations, some important problems in the geology of the State should still remain unresolved.

"As regards the belt of formations on the western side of the State, extending along the shore of Lake Champlain, the abundance of fossils and the almost undisturbed position of the strata have rendered their investigation comparatively easy, so that these formations were early identified with the lower members of the paleozoic series, from the Potsdam sandstone to the Hudson River group inclusive. Immediately eastward of this narrow strip is another belt of variable breadth, extending through more than half the length of the State, and passing northward into Canada. This consists of reddish sandstone and shales, and reddish, white, and gray limestones, which, from lithological peculiarities and the absence of distinct fossils, were much less easily referred to their proper geological position. Indeed it is only within a few years that this remarkable group of strata has been generally recognized as belonging to the period of the Oneida and Medina rocks, to which Mr. Hitchcock now refers them.

"As connected with the history of this investigation, Prof. Rogers felt some satisfaction in stating that in a paper entitled "Notes on the Geological Structure of Western Vermont, &c.," communicated by him to the American Association at Albany in 1851, the manuscript of which he now submitted, he gave a detailed account of numerous sections and longitudinal tracings made during preceding seasons, and in express terms announced the conclusion that

the rocks in question were referable to the Levant, or in other words the Medina period. As, however, the chief interest of the discussions arising on the occasion had reference to the supposed Taconic system of Prof. Emmons, to which Prof. Rogers's observations had been largely directed, his statement of the age of the red rocks and associated limestones excited comparatively little attention at the time, although he believes it was the first distinct announcement of the conclusion regarding the geology of this belt which is now generally received. He however thinks that Prof. Hall mentioned at the time having arrived at a similar result. As this paper was not published in the Transactions of the Association, but only mentioned by its title, Prof. Rogers asked to be allowed to insert in the Proceedings of the Natural History Society an extract setting forth the conclusion and the arguments on which it was founded. The extract, beginning with an account of the rocks on the eastern slope of the Snake and Buck Mountains, is as follows :—

"The general geological position of the red rocks here spoken of is clearly seen by following either of the sections from the western base of the Snake and Buck Mountain across the trough or valley above described. Here we ascend through the various divisions of the Matinal series from the Trenton to the top of the Hudson River group as here defined, each marked by characteristic fossils, and all maintaining a nearly uniform eastern dip ; and above the latter we find a series of red and greenish and grey sandstones and shales of great thickness, succeeded, where the exposures are unbroken, by arenaceous and argillaceous reddish and gray limestones, alternating with beds of sandstone similar to that beneath.

"Stratigraphically considered, this series of beds occupies the position of the Medina group of New York, or its equivalent the Levant series of Pennsylvania and Virginia. The sandstones and shales bear a close resemblance to those of the latter, not only in color, but in the profusion of fucoid-like markings which they display on some of the parting surfaces. The series of reddish and gray limestones which rest upon these massive arenaceous beds form an interesting feature in the geology of Vermont. Their alternation with layers of sandstone and shale, and their frequently reddish tint, would lead us to regard them as a continuation of the lower mass under somewhat new formative conditions. In the prolongation of this belt of sandstones and limestones towards the north, as at Winooski Falls, near Burlington, the latter mass is seen to consist in great part of a pinkish white fine-grained limestone

which towards the base contains layers of reddish limestone interstratified with red sandstone,—marking the transition from the arenaceous to the calcareous form of deposit.

"In none of the localities of this calcareous mass which I have examined, from the flank of the Snake Mountain to near the Canada line, have I found any well-marked organic remains. This fact of itself strongly favors the idea of its being but a peculiar development of the upper portion of the Medina group. Nor can it be objected to this that metamorphic action may have caused its present destitution of fossils. Through nearly the whole of the series of exposures extending due north toward the Canada line, it presents a gentle eastern dip, conforming to the subjacent fossiliferous beds of Matinal limestone and slate, from which it is separated only by the sandstones above described. From this we infer that it must have been as little exposed as these fossiliferous beds to agencies capable of obliterating its included fossils, and that therefore it has never been in any considerable degree a fossiliferous mass.

"We are further strengthened in the opinion that this calcareous group, with the subjacent sandstone, belongs to the Medina period by the consideration that the Clinton group, with which it might otherwise be compared, is almost everywhere an eminently fossiliferous one. From Alabama to northern New York, it is marked by an abundance of fossils. According to Mr. Logan, strata of this age are found in the vicinity of Lake Memphremagog, and, although there surrounded by metamorphic masses, they include a number of fossils in good preservation.

"On the whole, therefore, I think that the limestone and subjacent sandstone of which we are now treating must be regarded as one formation, and may with the highest probability be referred to the period of the Levant rocks or the Medina group of New York."

A careful re-examination of Snake Mountain is much required, for if the section it presents has been correctly interpreted then we must admit that palæontology is at fault, but if the displacement contended for by Emmons really does exist then the principles of the science will remain as before, unerring guides for us in our researches after truth.

MISCELLANEOUS.

THE EARTHQUAKE OF JULY 12, 1861

This was apparently more limited in its range, at least within Canada, than that of Oct. 1860. We have notices of it only from Montreal, Ottawa, Prescott, Ogdensburgh, Brockville, St. Andrews and St. Johns. It was more violent at Ottawa than elsewhere, shattering walls and throwing down chimneys. It occurred in all the above places about 9 o'clock, p. m. It appears, from collating the statements of several observers, that it was preceded by a rumbling noise, which was followed by a series of slight vibrations, terminating in a sudden shock. At Prescott, three shocks are said to have been experienced. Unless it extended into the Hudson's Bay territories, from which no accounts have been received, the theatre of the vibration was limited to the central district of Canada, surrounding the confluence of the Ottawa and St. Lawrence. J. W. D.

GEOLOGICAL SOCIETY OF LONDON.

In late numbers of the "Abstracts of Proceedings of the Geological Society of London," we find the following notices of papers relating to North American Geology:

April 10, 1861.—"On the Geology of the Country between Lake Superior and the Pacific Ocean (between 48° and 55° parallels of latitude), explored by the Government Exploring Expedition under the command of Captain J. Palliser (1857–60)." By James Hector, M.D. Communicated by Sir R. I. Murchison, V. P. G. S.

This paper gave the geological results of three years' exploration of the British Territories in North America along the frontier-line of the United States, and westward from Lake Superior to the Pacific Ocean.

It began by showing that the central portion of North America is a great triangular plateau, bounded by the Rocky Mountains, Alleghanies, and Laurentian axis, stretching from Canada to the Arctic Ocean, and divided into two slopes by a watershed that nearly follows the political boundary-line, and throws the drainage to the Gulf of Mexico and the Arctic Ocean. The northern part of this plateau has a slope from the Rocky Mountains to the eastern or Laurentian axis, of six feet in the mile, but is broken

by steppes, which exhibit lines of ancient denudation at three different levels; the lowest is of fresh-water origin; the next belongs to the Drift-deposits, and the highest is the great Prairie-level of undenuded Cretaceous strata. This plateau has once been complete to the eastern axis, but is now incomplete along its eastern edge, the soft strata having been removed in the region of Lake Winipeg.

The eastern axis sends off a spur that encircles the west shore of Lake Superior, and is composed of metamorphic rocks and granite of the Laurentian Series. To the west of this follows a belt where the floor of the plateau is exposed, consisting of Lower Silurian and Devonian rocks. On these rest Cretaceous strata, which prevail all the way to the Rocky Mountains, overlaid here and there by detached tertiary basins.

The Rocky Mountains are composed of Carboniferous and Devonian limestones, with massive quartzites and conglomerates, followed to the west by a granitic tract which occupies the bottom of the great valley between the Rocky and the Cascade Mountains. The Cascade chain is volcanic, but the volcanos are now inactive; to the west of it, along the Pacific coast, Cretaceous and Tertiary strata prevail. The description of these rocks was given with considerable detail on account of their containing a lignite, which for the first time have been determined to be of Cretaceous age. This lignite, which is of a very superior quality, has been worked for some years past by the Hudson Bay Company, and is in great demand for the steam-navy of the Pacific station, and for the manufacture of gas. Extensive lignite-deposits in the Prairie were also alluded to; and, like those above-mentioned, were considered to be of Cretaceous age; but, besides these, there are also lignites of the Tertiary period.

The general conclusion was that the existence of a supply of fuel in the Islands of Formosa and Japan, in Vancouver's Island, in the Cretaceous strata of the western shores of the Pacific, but principally within the British territory, and in the plains along the Saskatchewan, will exercise a most important influence in considering the practicability of a route to our Eastern possessions through the Canadas, the Prairies, and British Columbia.

"On Elevations and Depressions of the Earth in North America." By Dr. A. Gesner, F. G. S.

After some observations on the differences between volcanic uplifts of the land and the slow upward and downward shiftings

produced by changes in the position of great parallel areas during long periods of time, the author proceeds to enumerate evidences of local elevation and subsidence that he has observed along the coast from the Northern part of Labrador to New Jersey.

In the south-eastern part of New Jersey, at Nantucket, Martha's Vineyard, and Portland, submergence of the land is proceeding, locally at the rate of probably four feet in sixty years. In New Brunswick, at St. Johns the land has been elevated; at the Great Manan Island and the Great Tantamar Marsh there has been subsidence. At Bathurst and on the opposite coast of Lower Canada the land seems to be rising. In Nova Scotia, near the Bay of Fundy and Mines Basin there is subsidence; on the southern side, however, there are signs of elevation. The sea rapidly encroaches upon Louisberg in Cape Breton; and in Prince Edward's Island, also, at Cascumpec, submergence of the land is taking place.

June 5, 1861.—" On an erect Sigillaria from the South Joggins, Nova Scotia." By Dr. J. W. Dawson, F.G.S.

This specimen, presenting the external markings of leaf-scars and ribs with more than usual clearness and with some instructive peculiarities, has afforded to the author the type of a new species, *Sigillaria Brownii*. Observations on the probable style of growth, on the structure, and on the classification of *Sigillariæ*, were also given in this paper, together with a *résumé* of the observations previously published regarding *Sigillaria* by Brongniart, Corda, and others.

" On a Carpolite from the Coal-formation of Cape Breton." By Dr. J. W. Dawson, F.G.S.

Numerous *Trigonocarpa* belonging to a new species (*Trigonocarpum Hookeri*) occur in a thin calcareous layer in the coal-measures near Port Hood, Cape Breton. The author thinks it highly probable that though some *Trigonocarpa* may have belonged to Conifers, yet in this case they were the seeds of *Sigillaria*.

BOTANICAL SOCIETY OF CANADA.

Sixth meeting. Kingston, 12th April, 1861. Very Rev. Principal Leitch, President, in the chair.

The following candidates were balloted for and duly elected *Fellows*:—Hon. William Sheppard, D.C.L., of Fairymead, Drummondville, Lower Canada; J. Bruce, Hamilton, C. W.

The following were admitted as *Corresponding Members* :— John Richardson, Montreal; P. L. Simmonds, King's College, London, England; John Lowe, M.D., M.R.C.S. England, King's Lynn.

Donations to the library were announced from Mr. Stanton and Prof. Lawson. Letters were read from Dr. Greville, Edinburgh, and Mr. J. T. Syme, F.L.S., London. Interesting collections of specimens were exhibited from Mrs. Noel, and Dr. W. E. Dickson, Kingston. Mr. T. Sullivan presented a peculiar pilose polyporus, and Mr. A. T. Drummond, B.A., exhibited a number of dyes prepared from native lichens.

The Secretary announced the presentation to the Society by Mr. B. Billings, a Fellow, of a large and very valuable collection of plants, chiefly from the neighbourhood of Prescott. The Society's thanks were voted to Mr. Billings for his valuable donation.

The following papers were read:—

1. Remarks on the Silk obtained from Lettuce-fed Silk Worms. By Miss Gildersleeve.
2. Further observations on Silk Culture. By Mrs. Lawson.
3. Extracts from Letters relative to Silk and the native fibre-yielding Insects of Canada. By John Duff.
4. On Fungi, their relation to disease. By John Lowe, M. D., M.R.C.S. England, F.B.S.E., Surgeon to the West Norfolk and Lynn Hospital. [British American Journal, vol. II., p. 193.]
5. On the Secretion of Saccharine Matter in the Floral Organs of Plants, and on the Economy of Bees; with the results of investigations on the Sexual Development of Bees. By the Very Rev. Principal Leitch, President. Part II.

Seventh Meeting, 14*th June*, 1861. Rev. Prof. Mowat, M.A., afterwards Rev. Prof. Williamson, LL.D., Vice-President, in the chair.

The following *Subscribers* were admitted :—Miss Fisher, Newmarket; Rev. H. E. Plees, Carrying Place; John G. Giles, M.D., Farmersville; Rev. Mr. Borthwick, M.A., Ottawa; W. Carter Deans, M.D., Trenton; W. Weir, M.D.; H. D. Lord, Ladlowville, Tompkins Co., New York; Edward C. Fox, of Baliol College, Oxford, Trenton, C. W.; Samuel H. Fee, Kingston.

The following donations to the Society's Library and Herbarium, were announced.

1. Fragmenta Phytographiæ Australiæ, vol. I, from the au-

thor, Dr. Mueller, Botanist to the Colony of Victoria, Hon. M. B.S.C.

2. Memoir on the Pre-carboniferous Flora, from the author, Principal Dawson, Montreal, Hon. M.B.S.C.

3. Several popular works on Botany, from F. Stanton, 1st Royals, F.B.S.C.

4. Lichens, a large and beautiful collection, from Mr. B. Billings, F.B.S.C., Prescott.

5. Seeds from Mr. Horage, Erfurt, and Mr. Bruce, Hamilton.

Professor Lawson exhibited under the microscope, several species of Spirogyra in a beautiful state of conjugation, from the pond in Queen's College grounds.

The following papers were read:—

1. On the Geographical Distribution of the Coniferæ in Canada. By the Hon. William Sheppard, D. C. L., of Fairymead, Drummondville, Lower Canada.
2. Description of the Curculio, its mode of destroying Fruit, and the various means employed to check its progress. By Thomas Briggs, Jr.
3. Remarks on the species of Oak, their history, habits, and uses. By Miss Crooks, Hamilton, C. W.
4. List of the Lichens of the neighbourhood of Prescott, C. W. By B. Billings, jun.

Field meeting, 17*th June*, 1861. The members met at the Crystal Palace, Kingston, and proceeded a few miles beyond Collins' Bay, visiting the woods and swamps along the Bath Road. Many interesting plants, including ferns, orchids, carices, mosses, hepaticæ, lichens, algæ, &c., were collected, of which a list will be printed in the Society's Annals.

G. L.

NEW MINERAL.

Prof. How of King's College, Windsor, N. S., publishes in Silliman, the description of a new Boracic Acid Mineral from the Gypsum of Nova Scotia, for which he proposes the name "Cryptomorphate." It is found along with the Natro-boro-calcite, previously observed by him in the Gypsum qarries at Windsor.

"The mineral to which I would now draw attention was found in the same quarry as the preceding, at a distance of about 100

yards and at about 20 feet lower level, and also associated with Glauber-salt, which, it is worthy of notice, is generally met with here, according to the quarrymen, in narrow seams at the line of junction of the "hard plaster," (Anhydrite) with the soft "plaster," (Gypsum). I detected it in the form of an opaque white substance without lustre, and, to the naked eye, devoid of crystalline structure, in cakes and somewhat rounded masses varying in size from that of a small pea to that of a bean; these masses lay between gypsum and crystals of Glauber-salt, taking shape from the crystals of the latter on the side next to them, and when detached from them leaving their faces, as it were, etched, and sometimes the crystals were penetrated to a considerable depth by the imbedded borate. The mineral is very soft, (H = 1) but coherent, tasteless, slightly tough between the teeth, fuses readily B.B. to a clear bead, insoluble in water, soluble in HCl. As found, or very soon after being brought home, it lost by exposure to air, Water = 18·36 per cent,
and the air dry substances gave the following results on analysis; the water was determined by ignition, the lime, magnesia and sulphuric acid in one portion of the ignited residue, and the soda in another, after its treatment with fluor-spar and sulphuric acid for separation of boracic acid, which was, of course, estimated by deficiency:

	I.	II.
Lime, ...	14·21	——
Soda, ...	7·25	——
Sulphuric acid, ...	3·98	——
Magnesia	0·62	——
Water, ...	19·96	20·78
Boracic acid, ...	53·98	——
	100·00	

The quantity of mineral obtained did not permit me to make more than one analysis, and retain a little as a specimen for identification, but these results as well as the characters already mentioned, and the crystalline structure to which I shall presently advert, are, I think, sufficient to show that it is specifically distinct from Natro-boro-calcite (see analyses quoted.) On the assumption that the magnesia and sulphuric acid are accidental, and that the latter is combined with the former and with a quantity of soda equivalent to that of the acid not required by the magnesia, I have calculated the preceding results (I) after making

these deductions, and at the same time taking away the amount of water necessary to render the $MgOSO_3 = MgOSO_3 + 7$ aq.: (the hydrated sulphate of soda would of course become anhydrous on exposure to dry air); the results then become;

		Oxygen.	Ratio.	Calculation.		
Lime,	15·55	= 4·44	3·08	3CaO	84	15·64
Soda,	5·61	= 1·44	1·90	NaO	31	5·77
Water,	19·72	=17·52	12·16	12HO	108	20·11
Boracic acid,	59·10	=40·77	28·10	$9BO_3$	314·1	58·48
	99·98				537·1	100·00

corresponding to the formula,

$$NaO, 3CaO, B9O_3+12HO."$$

The late Prof. Robb remarks as follows on its crystalline form :—

"In spite of your odd formula, the mineral, just as I got it, untouched and unwashed, is perfectly crystalline in every particle. A good power is required, but with a magnifying power of about 350 diameters there is no difficulty, the form comes out as sharp as possible. The crystals are excessively thin translucent tables or plates. They have a rhombic outline and the angles probably = 80° or more, owing to their excessive thinness I could not say whether they could be called right or oblique rhombic prisms. I suspect the latter from analogy. By care the 'Tiza' (Natro-boro-calcite) can be shown to consist of very fine prisms, sharp, angular and long, but too fine for me to state their form. The diameter was less than ·00118 of an English inch. The long prismatic needles of the Tiza are in great contrast to the broad tables of the recent mineral in your last letter; of that the plates are about ·0048 of an inch from side to side, but some are a little larger, others a little smaller. In some you see regular cleavage, that is, a small rhomb chipped out of one side. As far as form goes therefore it would seem to be a distinct and definite species. I presume it was formed in a dry place for the angles were quite sharp. The connection between these borates and sulphate of lime and sulphate of soda is very curious."

Prof. How thus notices its bearing on the question of the mode of formation of gypsum :—

"The truth of the last sentence in Prof. Robb's letter is very apparent. In my former paper on the subject I adverted to the existence of Natro-boro-calcite in the Gypsum here as confirming

Dawson's theory of the origin of the rock from volcanic waters acting on the carbonate of lime; it is interesting to observe that Bechi found* the same mineral, with other borates, in the lagoons of Tuscany. The hydrated conditions of both the borates found in the rock here and of the associated Glauber-salt, shows the action of water, but that of ordinary sea-water would not account for the presence of boracic acid. As regards the soda, the sulphate and borate of lime were probably the substances originally present, and chlorid of sodium in water being introduced might remove part of the calcium as chlorid, and furnish borate and sulphate of soda; it is confirmatory of this view that a small quantity of rock-salt in crystalline grains has lately been found in the Gypsum."

Prof. How has also recognised the mineral *Gyrolite* associated with Apophyllite in the trap of Nova Scotia.

"STEEPS" FOR SEEDS.

Of the many "steeps" that have been recommended to facilitate the germination of seeds, the most intelligible is that of caustic potash, or carbonate of potash, applied by M. André Seroy to seeds naturally protected by fatty or oily pulp. He reports that the seeds of Hollies, Magnolias, Yews, and the like, which often do remain in the ground for a couple of years, come up readily after treatment with potash and subsequent rubbing with sand.

BLANCHING OF FLOWERS.

It it well known that light is as necessary to plants as a due supply of heat and moisture. The effects of its absence are often singular. We know that plants grown in darkness do not exhibit their usual healthy green color, light being required for the development of chlorophyll. Advantage is taken of this circumstance in the blanching of salads and vegetables, and the same process is now being applied to flowers. It appears that in Paris there is a great demand for white lilacs for ladies' bouquets in winter, and as the common white lilac does not force well, the purple "Lilas de Morly" is used. The flowers of this variety, when made to expand at a high temperature, in total darkness, are of a pure white; those of the Persian lilac will not whiten.

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* Dana's Min., 4th Ed., 394, 395.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ILE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF APRIL, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	8 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					8 a. m.	2 p. m.	10 p. m.
1	30.508	30.288	30.200	10.4	29.2	26.1	.048	.123	.105	.69	.77	.75	N. E. by E.	N. E. by E.	N. E. by E.	225.40	3 0	....	....	Clear.	Cu. Str. 10.	Cirr. Str. 10. Snow.
2	162	159	220	26.2	34.0	26.1	.111	.170	.106	.86	.80	.80	N. E. by E.	N. E. by E.	N. E. by E.	224.70	5.0	....	7.23	Snow.	Snow.	Snow.
3	246	318	347	25.1	38.2	27.1	.117	.185	.111	.87	.80	.75	N. E. by E.	N. E. by E.	W. N. W.	52.86	8.0	....	1.10	Cu. Str. 10.	C. Cur St. 6.	Clear. Zod. light, bright.
4	280	108	212	15.4	53.4	31.9	.065	.321	.147	.74	.80	.80	S. W.	W. S. W	W. S. W.	2.60	2.0	....	....	Clear.	Clear.	" " "
5	190	173	347	23.7	57.6	33.4	.100	.236	.162	.79	.63	.84	N. E.	S. S. W.	N.W. by W.	61.00	2.0	....	....	"	"	" ft. Aurora Borealis.
6	260	387	332	27.1	56.1	33.2	.111	.282	.162	.75	.63	.86	S. E. by E.	S. E. by E.	S. W.	81 40	1.0	....	....	"	"	"
7	257	252	329	24 1	50.3	31.6	.105	.186	.110	.75	.61	.64	S. by W.	W. S. W.	W. by N.	85.10	2.0	....	....	"	"	" Aurora Borealis.
8	247	381	300	21.1	42.9	30.6	.085	.092	.136	.71	.34	.83	N. E. by E.	N. E. by E.	N. E. by E.	113.80	1.0	....	....	"	"	"
9	124	107	039	20.8	47.4	18 5	.069	.225	.180	.63	.70	.77	N. E. by E.	N. E. by E.	N. E. by E.	59.80	1.0	....	....	"	"	" ft. Aurora Borealis.
10	007	29.945	29 957	20.2	61.0	42.0	.089	.413	.102	.72	.77	.61	N.	N.	S. S. W.	0.10	1.0	....	....	"	"	Str. 2. Aurora Streamers.
11	008	30.606	30.101	30.0	64 6	36.5	.130	.231	.170	.78	.65	.80	N. E. by E.	E. S. E.	N. E. by E.	85.30	2.0	....	....	"	"	Clear. ft. Aurora Borealis.
12	020	29.920	29.874	27.2	52 8	45.0	.111	.276	.251	.75	.70	.84	N. E. by E.	S. by E.	S. S. E.	98.96	3.6	Inapp.	....	Cu. Str. 2.	C. C. Str. 10.	Cirr Str. 10.
13	29.714	474	511	42.1	52.1	44 6	.244	.361	265	.91	.93	.91	S. E. by E.	S. E. by E.	S. S. W.	88.50	4.5	0.831	....	Rain.	Rain.	Fog.
14	397	411	647	40.3	47.6	36.7	.241	.249	.184	.90	.77	.85	S. E. by E.	S. E. by E.	W. S. W.	151.20	3.6	Inapp.	....	Fog.	Cu. Str. 10.	Cirr Str. 10
15	747	740	914	31.6	40.9	32.4	.149	.145	.143	.84	.60	.79	W. by S.	W. S. W.	W. S. W.	209.80	2.0	....	....	C. C. Str. 10.	" 3.	Clear. Aurora Borealis.
16	934	879	790	26.9	40.3	33.3	.093	.145	.162	.64	.60	.84	N. E. by E.	N. E. by E.	N. E. by E.	134.00	2.5	....	....	Clear.	Cu. Str. 10.	Cu. Str. 10.
17	245	247	127	30.4	34 2	32.7	.130	.175	.156	.78	.89	.85	N. E. by E.	N. E. by E.	N. W. by N.	540.80	4.0	....	3.35	Soow.	Snow	C. C. Str. 8.
18	364	531	467	26.4	40 1	35.0	.105	.208	.162	.78	.82	.80	W. S. W.	S. W.	S. W.	174.70	2.0	....	....	Clear.	C. C. Str. 4.	" 4.
19	550	642	739	33.4	45.8	32 9	.144	.204	.137	.78	.68	.74	N. N. W.	W. S W.	W. S. W.	28.40	3.0	....	....	"	" 10.	Clear.
20	814	900	801	31.7	52.1	39.2	.130	.251	.195	.74	.63	.82	W. by E.	W. S. W.	W. S. W.	29.70	3.0	....	....	C. C. Str. 8.	Clear.	Cu. Str. 10.
21	779	879	931	35.4	51.7	41.2	.162	.252	.197	.80	.68	.79	W. S. W.	W. N. W.	W. S. W.	132.90	2.0	....	....	Clear.	Clear. Solar Halo.	Str. 2.
22	871	771	731	38.2	42.2	43.0	.206	.206	.261	.90	.78	.96	E. by N.	N. E. by E.	N. E. by E.	48.20	3.5	0.126	....	Cu. Str. 10.	Cu. Str. 10.	Rain.
23	741	791	879	41.9	53.6	46.7	.228	.355	.286	.87	.84	.92	S. E.	S. W.	E. N. E.	46.40	4.0	0.614	....	" 10.	C. C. Str. 10.	C. C. Str. 10.
24	687	661	647	40.0	46.8	44.2	.210	.280	.225	.89	.88	.80	N. E. by E.	N. E. by E.	S.	75.40	3.6	0.160	....	Rain.	Rain.	Cirr Str. 10.
25	517	674	967	40.1	48.2	41.0	.215	.242	.212	.91	.74	.82	W. S. W.	W.	W. by W.	229 80	2.0	....	....	Clear.	Cu Str. 4.	" 8.
26	900	924	30.006	40.1	58.2	44.1	.203	.309	.265	.82	.64	.92	W. by N.	W. by N.	S. S W.	92 20	1.5	....	....	C. C. Str. 6.	Clear.	Str. 2.
27	900	742	29.667	35.7	58.7	39 2	.188	.372	.195	.76	.78	.82	N. E. by E.	N. E. by E.	N. E. by E.	181.50	3.0	....	....	" 8.	Cu. Str. 9.	Cu. Str. 9.
28	412	394	514	38.4	85.0	46.3	.165	.355	.305	.72	.84	.96	N. E. by E.	E, S. E.	S.	227.60	3.5	0.836	....	" 4.	Rain.	Rain.
29	711	700	710	43.6	65.7	62.0	.215	.396	.308	.79	.65	.79	W.	S.	S. S. E.	43.76	3.0	0.256	....	" 8.	Clear.	Clear. Comet visible.
30	747	640	689	43.6	49.0	45.4	.254	.303	.269	.92	.89	.88	N. by W.	E. S. E.	W. N. W.	50.60	3.5	0.710	....	" 10.	Rain.	Rain.
...	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	.....	.....	.....	....	....	....	....	....	....	....

REPORT FOR THE MONTH OF MAY, 1861.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c., &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	29.651	29.752	29.950	35.3	46.0	33.0	.149	.192	.131	.74	.62	.9	N. N. W.	N. W.	N. W	205.40	2 5	Inapp.	....	Clear.	Clear.	Clear. Frost.
2	937	897	923	24 2	42.9	33.0	.096	.171	.156	.73	.62	.5	W. N. W.	W. S. W.	W.	223.60	1.0	....	....	" Frost.	"	"
3	979	920	900	29.0	46.7	38.9	.128	.208	.180	.77	.66	.7	N. by W.	S. S. W.	S S. W.	100.50	2.0	....	....	"	"	"
4	902	997	910	33.1	52 4	44.7	.156	.282	.234	.85	.73	.9	S. by E.	S. S. E.	S. S. E.	60.30	1.5	....	....	"	"	" ft. Aurora Borealis.
5	897	729	914	39.1	67.0	50.8	.186	.470	.258	.77	.73	.7	S. W.	S.	S.	154.00	1.5	....	....	"	"	"
6	716	576	482	39.0	60.0	48.1	.180	.433	.291	.77	.85	.9	N. N. E.	E. by S.	E. N. E.	138.90	2.0	....	....	Cu. Str. 4.	C. C. Str. 6.	Rain.
7	28.900	174	166	50 9	65.1	49.1	.283	.375	.322	.78	.83	.2	S. by W.	S. W.	S. W.	437.40	3.5	2 242	....	" 8.	" 10.	Cirr Str. 10.
8	29.263	380	480	47.0	57.0	48.3	.280	.208	.200	.88	.69	.3	W. S.W.	S. S. W.	N. W.	284.10	3.6	0.016	....	C. C. Str. 6.	Cu Str. 6.	" 10.
9	671	714	766	44.4	60.0	50.0	.218	.201	.265	.76	.61	.3	W. by N.	S. W.	S. W.	105.00	1.0	....	....	" 8.	" 2.	" 8.
10	770	714	591	45.2	65.9	52.1	.234	.265	.264	.80	.42	.0	S. S. W.	S. E.	E. S. E.	114.50	1.0	....	....	Clear.	Clear.	Clear.
11	554	689	689	46.0	65.9	56.0	.221	.359	.336	.72	.58	.3	N. E. by E.	S. S. E.	S. S. W.	53.70	2.5	....	....	C. C. Str. 8.	C. C. Str. 10.	C. C. Str. 9.
12	698	750	839	54 0	63.7	55.0	.277	.392	.349	.75	.69	.8	N. E. by E.	N. E. by E.	S. S. W.	29.70	3.0	0.160	....	Rain.	Cirr. 4. Solar Halo.	Clear.
13	853	708	642	45.1	67.9	54.2	.251	.362	.362	.84	.55	.8	N. E. by E.	S E.	S. S. E.	178.70	2.6	Inapp.	....	Clear.	C. C. Str. 8.	Cu. Str. 8.
14	556	520	503	51.0	58.1	53.7	.348	.469	.269	.95	.94	.9	S. S. E.	S. S. W.	S. W.	230.90	3.0	0.820.	....	Rain.	Rain.	" 10.
15	643	679	701	47.5	58.0	53.2	.291	.265	.321	.89	.76	.8	W. by S.	S. S. W.	S. S. E.	0.30	2.0	....	....	Cu. Str. 10.	Clear.	Clear.
16	509	478	618	48.8	58.4	48.5	.302	.337	.285	.82	.70	.8	S. S. W.	W. S. W.	S. S. W.	232.40	2.0	0.262	....	Raiu.	C. C. Str. 4.	Cum Str. 8.
17	659	748	929	39.8	51.7	60.0	.201	.302	.272	.86	.32	.7	W. S. W.	W.	W. N. W.	651.00	3 0	0.100	....	"	Cu Str. 9.	" 4.
18	898	946	30.016	44.1	61.3	48.3	.224	.252	.285	.79	.68	.8	W.	W. by N.	N. N. W.	250.70	2.5	Inapp.	....	Cu. Str. 10.	C. C. Str. 8. Solar Halo	" 9.
19	30.009	930	29.904	43.1	68.7	52.5	.245	.509	.204	.92	.75	.6	W.	S. S. W.	S. W.	90.70	2 0	....	....	Clear.	" 4.	" 8.
20	29.857	820	862	44.3	64 2	81.8	.248	.285	.296	.88	.48	.7	S. W.	N. N. E.	N. N. E.	59.46	2.0	....	....	"	" 8.	" 4.
21	902	857	882	48 6	68.1	62.2	.285	.365	.334	.85	.76	.8	N. by E.	S. W.	W. S. W.	145.80	2.5	Inapp.	....	Cirr. 8.	Cu Str. 10.	Clear.
22	950	995	960	45.0	57.0	56.2	.251	.340	.315	.84	.52	.7	N. E. by E.	W. N. W.	W. by S.	67.80	2.6	....	....	" 4.	Clear.	"
23	30.102	30.106	30 026	61.0	77.1	61.2	.277	.492	.413	.75	.53	.7	W.	W. S. W.	S. W.	60.70	2.0	....	....	Clear.	"	C. C. Str. 9.
24	29 970	29.821	29.757	65 3	72.0	61.0	.349	.489	.433	.81	.62	.8	W. S. W.	S. S. E.	S. S. E.	184.20	2.5	Inapp.	....	"	Cu Str. 10.	Cu. Str. 4.
25	505	476	537	54 2	70.2	60.8	.390	.516	.338	.93	.70	.6	S. S. E.	S. W.	S. W.	93.90	3 5	0.300	....	Cu. Str. 10.	C. C. Str. 4.	" 4.
26	524	506	405	60.0	74.2	60.3	.336	.442	.403	.78	.55	.7	W. S. W.	W.	S. S. W.	47.40	2 0	....	....	Cir Cum.St.4.	" 4.	" 4.
27	122	28.883	28.938	84 4	56.0	49.5	.383	.427	.315	.90	.97	.8	S. S. E.	N. E. by E.	S. S. W	152.30	3 5	2 086	....	Rain.	Rain.	Showers.
28	256	29.432	29.654	46.0	57.0	44.2	.265	.413	.282	.92	.90	.9	S. W.	W. N. W.	W.	230.30	6.0	1.360	....	"	"	"
29	744	739	909	46.7	55.0	49.0	.305	.390	.285	.96	.93	.8	W.	W. N. W.	W.	221.70	4.0	0.436	....	Cu. Str. 10.	Cirr Str 4.	Clear.
30	30.006	963	30.155	46.1	71.0	57.2	.269	.378	.302	.88	.51	.6	W.	W. S. W.	W. S. W.	237.60	2.0	....	....	Cirr. 2.	Clear.	"
31	232	30.102	027	51.0	68.9	48.2	.258	.536	.242	.71	.77	.74	W. S. W.	W. S. W.	S. W.	242.20	2.0	....	....	Clear.	"	"

REMARKS FOR APRIL, 1860.

Barometer: Highest, the 1st day, 30·508 inches. Lowest, the 17th day, 29.127 ". Monthly Mean, 29.882 ". " Range, 1·381 ".

Thermometer: Highest, the 29th day, 65°7. Lowest, the 1st day,—10°4. Monthly Mean, 38°99. Monthly Range, 65°3.

Greatest intensity of the Sun's rays, 77°3.
Lowest point of Terrestrial radiation,—9°1.
Mean of Humidity, .780.
Rain fell on 9 days, amounting to 2.921 inches; it was raining hours and 42 minutes, and was accompanied by distant thunder on 1 day.
Snow fell on 3 days, amounting to 11·68 inches; it was snowing 46 hours and 35 minutes.
Most prevalent wind, the N. E. by E.
Least prevalent wind, the N.
Most windy day the 17th day, mean miles per hour, 22.53.
Least windy day the 10th day, mean miles per hour, 0.40.
Aurora Borealis visible on 7 nights.
Zodiacal Light bright.
The Electrical state of the Atmosphere has indicated moderate intensity.
Swallow *Hirundo Bicolor*, first seen23rd day.
Frogs *Rana fontinalis*, first heard 24th day.
Wild Geese *Anser Canadiensis*, first seen passing N. W. 23rd day.
Song Sparrow *Frangilla Melodia*, first heard 4th day.
Thatcher's Comet seen 29th.

REMARKS FOR MAY, 1861.

Barometer: Highest, the 31st day, 30.232 inches. Lowest, the 27th day, 28.883 ". Monthly Mean, 29.721 ". Monthly Range, 1·349 ".

Thermometer: Highest, the 26th day, 74°2. Lowest, the 2nd day,—21°3. Monthly Mean, 51°80. Monthly Range, 42°9.

Greatest intensity of the Sun's rays, 85°0.
Lowest point of terrestrial radiation,—19°3.
Mean of humidity, ·770.
Rain fell on 16 days, amounting to 8.642 inches, it was raining 49 hours, 32 minutes, and was accompanied by thunder on 1st day.
Most prevalent wind, W. S. W.
Least prevalent wind, N. N. W.
Most windy day, the 7th day; mean miles per hour, 18.22.
Least windy day, the 15th day; mean miles per hour, 0.01.
2 Solar Haloes were visible.
Aurora Borealis visible on 1 night.
The Electrical state of the Atmosphere has indicated feeble intensity.
Shad *Alosa Prostabilis*, first caught 30th day.
Amount of evaporation, 2·93 inches.

* Dana's Min., 4th Ed., 394, 395.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF JUNE, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	30.042	29.905	29.905	64.6	79.9	65.6	.335	.667	.413	.80	.37	.66
2	032	938	800	55.7	81.2	67.0	.349	.547	.450	.81	.62	.67
3	29.474	811	564	60.1	77.0	63.7	.449	.685	.510	.85	.75	.88
4	850	717	021	49.0	65.8	53.8	.278	.436	.367	.81	.80	.88
5	30.117	30.063	30.126	48.4	72.3	59.0	.260	.340	.387	.78	.45	.70
6	041	29.993	29.937	52.3	67.7	67.6	.334	.418	.343	.86	.62	.72
7	29.904	876	800	59.6	72.8	70.6	.433	.456	.586	.85	.48	.80
8	862	772	898	68.7	80.4	63.0	.452	.567	.485	.94	.57	.86
9	768	785	892	67.0	89.8	74.9	.556	.900	.673	.84	.71	.79
10	843	770	630	70.9	95.8	76.7	.621	.949	.614	.85	.78	.68
11	625	472	462	70.1	94.9	75.5	.516	.814	.597	.79	.54	.71
12	435	472	632	69.5	79.2	60.8	.628	.581	.333	.88	.60	.63
13	788	755	790	56.2	63.0	51.0	.342	.229	.270	.78	.41	.72
14	822	755	750	58.0	68.5	54.0	.337	.343	.341	.70	.49	.83
15	500	363	434	56.1	64.2	58.1	.420	.464	.452	.94	.77	.94
16	477	567	790	56.6	73.0	62.0	.391	.383	.284	.87	.48	.69
17	833	868	842	58.1	69.6	56.5	.255	.437	.357	.53	.63	.78
18	791	814	869	50.2	84.7	57.6	.328	.427	.372	.89	.71	.78
19	689	576	697	60.4	80.9	63.2	.433	.598	.516	.85	.50	.88
20	662	747	811	58.4	64.1	58.3	.372	.433	.394	.78	.73	.82
21	675	546	562	60.9	61.2	59.1	.419	.442	.439	.80	.83	.88
22	574	564	555	59.3	62.4	69.0	.462	.399	.564	.91	.72	.79
23	420	428	640	67.6	67.2	51.0	.591	.656	.392	.89	.84	.82
24	616	735	850	43.2	69.6	57.0	.209	.336	.302	.75	.47	.66
25	842	772	700	55.0	67.9	68.7	.328	.921	.571	.77	.71	.82
26	583	584	614	68.4	77.0	65.9	.612	.685	.444	.90	.75	.71
27	720	715	751	64.2	73.6	64.3	.471	.504	.464	.81	.61	.77
28	660	565	732	61.2	69.7	66.0	.388	.490	.509	.71	.68	.81
29	733	704	706	60.1	78.2	62.4	.376	.450	.422	.73	.67	.75
30	668	684	661	64.6	78.7	61.0	.444	.588	.419	.75	.62	.80
...	......	......	......	......	......	......	......	......	......	....	....	....

Day of Month.	Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	S. W.	S. W.	S. W.	88.44	3.0	....	....	Clear.	Cum. 2 Solar Halo.	Cirr. 2. Lunar Halo.
2	N. E. by E.	N. E. by E.	S. E.	139.50	3.0	....	....	Cirr. Str. 4.	Ligt Cirr. 2 Solar Halo	Cirr. Str. 8.
3	S. S. E.	W. S. W.	W. N. W.	333.70	3.5	2.333	....	Rain.	C. C. Str. 8.	“ 8.
4	N. N. W.	W. S. W.	N.	218.70	2.0	....	....	Clear.	Light Cirr. 4.	Clear.
5	S. S. E.	S. E. by E.	S. E. by E.	85.30	2.0	....	....	“	Clear.	Cirr. Str. 6.
6	S. S. E.	S. E.	S. E.	169.30	2.0	....	....	C. C. Str. 10.	C. C. Str. 8.	C. C. Str. 8.
7	E. S. E.	S. by E.	S. S. E.	28.00	2.5	0.100	....	Cu. Str. 8.	Cirr. 4.	Clear.
8	S. E.	S. by E.	S. by W.	5.70	2.0	....	....	Clear.	Clear.	Cu. Str. 8.
9	S. S. E.	S. W.	S. W.	54.90	2.0	....	....	“	“	“ 4.
10	S. by W.	S. by W.	S. S. W.	35.70	2.6	....	....	“	“	Clear.
11	S. W.	S. S. W.	S. W. by W.	10.20	1.5	....	....	“	“	Cirr. 4.
12	W. S. W.	W. S. W.	N. by W.	211.10	2.5	....	....	Cu. Str. 10.	Cu. Str. 4.	Clear.
13	W.	W.	W.	253.50	3.0	Inapp.	....	Nim. 10.	“ 4.	Cu. Str. 4.
14	W. S. W.	W. S. W.	S. W. by S.	306.80	2.5	....	....	Clear.	C. C. Str. 6.	Nim. 10.
15	E. S. E.	N. E. by E.	S. W.	72.40	4.0	0.989	....	Rain.	Rain.	Cu. Str. 8. Lightning.
16	N. N. E.	N. N. E.	N. by E.	264.00	2.5	0.700	....	Nim. 10.	Clear.	Clear.
17	S. E. by E.	S. E.	S. S. W.	118.00	1.5	....	....	Clear.	“	“
18	S. W.	S. W.	S. W.	132.00	1.0	....	....	“	“	“
19	S. by W.	S. S. W.	W. S. W.	157.80	2.5	0.236	....	C. C. Str. 10.	C. C. Str. 4.	C. C. Str. 4. Distant Thunder.
20	W. by N.	W. S. W.	W. S. W.	230.39	2.5	....	....	Nim. 10.	“ 8.	Clear.
21	S. S. W.	S. S. E.	S. E. by E.	26.20	2.5	Inapp.	....	Heavy dew.	Cirr. 10.	Cu. Str. 10.
22	W. by S.	W. by S.	S. S. W.	222.50	2.0	....	....	C. C. Str. 9.	Cu. Str. 4.	“ 8.
23	W. S. W.	W. by S.	W. by S.	393.70	3.0	0.010	....	“ 4.	“ 8.	“ 8.
24	W. by N.	W. by N.	W. N. W.	200.60	2.5	....	....	Clear.	Cirr. 2.	Clear.
25	S. W. by W.	S. S. W.	S. S. W.	66.30	2.0	....	....	Cu. Str. 8.	Clear.	“
26	S. S. W.	W.	W.	275.10	3.5	0.200	....	“ 8.	Cu. Str. 9.	Cu. Str. 8.
27	W. by N.	W. by N.	W. by N.	156.70	3.0	....	....	Clear.	Clear.	“ 4.
28	W. S. W.	S.	W. S. W.	218.70	2.0	0.300	....	“	Nim. 9.	Clear.
29	S. W. by S.	W. S. W.	W. S. W.	177.80	2.0	....	....	“	Cirr. 4.	“ Aurora Borealis.
30	W. by S.	W. S. W.	S. E.	177.10	1.0	....	....	C. C. Str. 8.	Cu. Str. 10.	Cu. Str. 8. Comet first seen.
...	......	......	......	....	....	....	....	....	....	....

REPORT FOR THE MONTH OF JULY, 1861.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.
1	29.701	29.742	29.763	66.6	71.4	59.4	.385	.609	.358	.84	.68	.73
2	701	670	675	54.5	58.3	56.9	.383	.394	.429	.90	.82	.91
3	729	845	831	61.0	76.0	65.0	.449	.652	.516	.85	.73	.84
4	862	874	895	61.0	85.1	66.3	.433	.577	.470	.85	.49	.73
5	840	770	794	71.8	91.0	72.0	.666	.894	.601	.74	.64	.78
6	781	713	800	70.0	93.6	75.0	.557	.793	.507	.77	.50	.71
7	888	775	722	72.4	89.6	77.0	.681	.798	.765	.81	.63	.84
8	683	783	550	74.0	89.7	66.6	.636	.714	.529	.83	.52	.82
9	475	511	400	70.2	81.0	67.7	.657	.717	.584	.77	.70	.87
10	470	674	702	67.0	76.0	65.1	.529	.652	.549	.82	.73	.80
11	590	528	677	51.3	57.4	67.0	.341	.406	.385	.89	.34	.84
12	633	599	781	54.1	62.1	55.2	.362	.376	.376	.87	.69	.87
13	882	976	987	68.5	77.6	58.0	.429	.457	.423	.91	.49	.88
14	30.037	869	902	56.4	72.4	60.1	.385	.483	.456	.84	.61	.88
15	29.776	709	714	56.1	62.3	60.0	.420	.523	.469	.94	.94	.94
16	656	603	666	63.2	69.9	60.3	.510	.577	.456	.88	.85	.88
17	688	705	854	63.9	73.2	59.0	.321	.416	.416	.80	.52	.85
18	752	713	688	61.1	83.3	70.4	.390	.505	.516	.74	.51	.90
19	696	682	568	64.0	70.4	65.2	.497	.530	.542	.83	.69	.87
20	420	405	470	63.0	74.1	60.0	.503	.442	.456	.86	.55	.88
21	57[illegible]	588	632	60.1	72.6	58.6	.426	.483	.387	.82	.61	.79
22	6[illegible]0	612	760	60.0	66.0	57.0	.345	.353	.385	.68	.56	.84
23	762	762	853	60.0	72.1	61.5	.433	.455	.466	.85	.56	.85
24	921	869	976	56.7	77.2	61.7	.385	.534	.436	.84	.59	.80
25	930	942	980	57.6	74.2	65.8	.349	.436	.609	.74	.53	.81
26	904	904	875	66.1	84.1	69.1	.542	.600	.536	.87	.51	.77
27	835	832	838	71.9	78.0	71.0	.537	.671	.688	.71	.71	.92
28	891	735	712	69.0	85.0	71.3	.571	.691	.615	.82	.57	.83
29	688	760	833	69.0	79.0	69.4	.642	.907	.380	.92	.93	.56
30	748	722	755	70.4	88.9	69.0	.621	.908	.536	.85	.68	.77
31	844	800	736	67.6	79.7	68.2	.584	.724	.584	.87	.72	.87

Day of Month.	Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &C., &C. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	S. S. E.	S. S. E.	N. E. by E.	439.20	2.0	0.170	....	Cu. Str. 10.	C. C. Str. 4.	Cirr. Str. 8.
2	N. E. by E.	N. N. E.	N. E. by E.	495.00	3.0	3.210	....	Rain.	Rain.	Rain.
3	N. N. E.	S. S. W.	S. S. E.	218.22	2.0	0.300	....	Cu. Str. 10.	Cu. Str. 10.	Clear. Comet visible.
4	S. W.	S. S. W.	S. S. W.	211.60	1.0	....	....	Clear.	Clear.	“ “ “
5	S. S. W.	S. S. W.	S.	92.60	1.0	....	....	“	“	“ “ “
6	S.	S. S. E.	S. by W.	77.80	1.0	....	....	“	“	“ “ “
7	S. by W.	S. W.	S. W.	121.10	1.5	....	....	Cirr. Cum. 6.	C. C. Str. 4.	Rain.
8	S. S. W.	S. S. W.	S. E.	177.00	2.0	....	....	C. C. Str. 6.	Cirr. 4.	Nim. 10.
9	S. S. W.	S. S. W.	W. N. W.	70.84	2.0	1.310	....	Cu. Str. 8.	C. C. Str. 4.	Cu. Str. 4.
10	E. S. E.	N. E.	N. N. E.	84.00	1.0	....	....	C. C. Str. 4.	Clear.	Clear.
11	N. E. by E.	N. E. by E.	E. by S.	427.50	2.5	0.863	....	Rain.	Cu. Str. 4.	“ Aurora Borealis.
12	S. S. W.	S. W.	W. by S.	208.60	2.6	....	....	C. Cum. 4.	“ 6.	Str. 2. “ “
13	S. W.	S. W.	N. E. by E.	55.40	3.0	0.074	....	“ 4.	“ 8.	Clear. “ “
14	N. E. by E.	E. S. E.	E. S. E.	58.30	2.0	....	....	C. C. Str. 6.	C. C. Str. 4.	C. C. Str. 4.
15	N. E. by E.	S. W. by S.	S. W. by S.	94.20	2.6	0.696	....	Rain.	Rain.	Rain.
16	S.	S. S. W.	S. by W.	166.10	2.5	0.603	....	C. C. Str. 10.	“	Cu. Str. 4.
17	W. S. W.	S. W.	S. S. W.	150.60	1.0	....	....	Clear.	C. C. Str. 4.	Clear.
18	S. S. W.	S. S. W.	E. S. E.	90.90	1.0	....	....	Cirr. Str 2.	“ 4.	Cirr. 10. Distant lightning.
19	W. S. W.	W. S. W.	N. E. by E.	79.30	1.6	1.126	....	Cu. Str. 10.	“ 4.	Cu. Str. 10.
20	E.	N. W.	W. by S.	67.10	2.0	0.576	....	Rain.	Cu. Str. 9.	“ 4.
21	W. by N.	W. by N.	W. by N.	364.00	2.0	0.131	....	“	“ 4.	Clear.
22	S. W.	W.	W.	230.40	1.0	....	....	Clear.	C. C. Str. 8.	Cu. Str. 4.
23	E. by N.	N. N. E.	W. S. W.	75.00	1.0	....	....	Cu. Str. 4.	Cu. Str. 10.	C. C. Str. 10.
24	W. S. W.	S. W. by W.	S. S. E.	6.20	1.0	....	....	C. C. Str. 10.	C. C. Str. 4.	Clear.
25	S.	S. S. E.	S. S. E.	0.70	1.5	....	....	Clear.	Cu Str. 4.	“ Aurora Borealis.
26	S. by E.	S. S. E.	S. S. E.	0.50	1.5	....	....	“	Clear.	Cu. Str. 2.
27	S. S. E.	N. W.	E. S. E.	53.60	2.5	0.200	....	Cu. Str. 10.	C. C. Str. 6.	Rain.
28	S. S. E.	S. S. E.	S. S. E.	50.80	1.0	....	....	Clear.	“ 4.	C. C. Str. 2.
29	S.	S. S. E.	S. S. E.	204.70	2.0	0.163	....	Rain.	Cu. Str. 6.	Cu. Str. 4.
30	S. S. W.	S. S. W.	S.	87.20	1.0	....	....	C. C. Str. 8.	C. C. Str. 4.	Clear.
31	S. by E.	S. by W.	S. S. E.	76.40	1.5	0.766	....	Rain.	“ 8.	Str. 4.

REMARKS FOR JUNE, 1860.

Barometer .... Highest, the 6th day, 30·126 inches.
Lowest, the 3rd day, 29.311 “
Monthly Mean, 29.720 “
“ Range, 0.815 “

Thermometer ... Highest, the 9th day, 99°7.
Lowest, the 17th day, 40°1.
Monthly Mean, 65°83.
Monthly Range, 59°6.

Greatest intensity of the Sun's rays, 104°3.
Lowest point of Terrestrial radiation,—36°4.
Amount of evaporation, 3·73 inches.
Mean of Humidity, .735.

Rain fell on 10 days, amounting to 4.868 inches; it was raining 56 hours and 18 minutes, and was accompanied by thunder on 3 days.
Most prevalent wind, the W. S. W.
Least prevalent wind, the N.
Most windy day the 23rd day, mean miles per hour, 12.23.
Least windy day the 8th day, mean miles per hour, 0.25.
Solar Haloes visible on 2 days.
Lunar Halo visible on 1 night.
Aurora Borealis visible on 1 night.
The Electrical state of the Atmosphere has indicated moderate intensity.

REMARKS FOR JULY, 1861.

Barometer. ...... Highest, the 14th day, 30.037 inches.
Lowest, the 9th day, 29.400 “
Monthly Mean, 29.734 “
Monthly Range, 0.637 “

Thermometer. Highest, the 6th day, 99°2.
Lowest, the 23rd day,—47°4.
Monthly Mean, 67°66.
Monthly Range, 51°8.

Greatest intensity of the Sun's rays, 104°1.
Lowest point of terrestrial radiation,—47°0.
Mean of humidity, ·765.
Amount of Evaporation, 2·72 inches.
Rain fell on 14 days, amounting to 10·188 inches, it was raining 79 hours, 49 minutes, and was accompanied by thunder on 4 days.
Most prevalent wind, S. E. by E.
Least prevalent wind, E.
Most windy day, the 2nd day; mean miles per hour, 20.60.
Least windy day, the 26th day; mean miles per hour, 0.02.
Aurora Borealis visible on 4 nights.
Comet visible.
Earthquake felt here at 9.05. p. m. 11th day.
Tornado in Montreal 9th day.
The Electrical state of the Atmosphere has indicated moderate intensity.

* Dana's Min., 4th Ed., 394, 395.

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ARTICLE XXIV.—*Recollections of the Swans and Geese of Hudson's Bay.* By George Barnston, Esq., of the Hon. Hudson's Bay Company.

(*Read before the Montreal Natural History Society.*)

The birds comprising the two Genera *Cygnus* and *Anser*, are, with slight exception, the largest of the palmipedes or web-footed fowls found in North America, and being generally difficult of approach, and at same time highly prized as an article of food, any account of their migrations and habits becomes interesting. Of the many who may have enjoyed the relish of a well-seasoned wild goose at the sumptuous banquet, few are aware of the distance the bird may have travelled, or of the many perils, by flood and field, through which it may have passed.

On the coast of Hudson's Bay their manners may be studied to great advantage. There they repose after a long and fatiguing flight, there they enjoy a perfect surfeit on the juicy roots of the swamps, and the tender sprouting herbage of the boundless downs; and there assembled in mass along the sea-girt shore, they follow the never-varying course of the points and headlands, that stand out revealed as the line of march of all their ancestors who have gone before them.

The swan, except in a few particular localities, is a scarce, rather than a plentiful bird, on the shores of Hudson's Bay. Of somewhat ponderous flight, swans are seen at the same time as the other migratory tribes, winging their way to the secluded recesses of the north, resting themselves throughout the interior, and losing units of their number here and there by the Indian's gun. In the scarcity of their favourite food—the tubers of the *Sagittaria sagittifolia*—they have recourse to the roots of other plants, and the tender under-ground runners of grasses, in the higher latitudes. They sometimes breed in the interior, before arriving at the coast. I had two eggs brought to me from the borders of a lake near Norway House, lat. nearly 55° N. But it was impossible for me to say, whether these were of the *Cygnus Americanus*, or *C. Buccinator*. The probability rests with the former.

Towards Eastmain James's Fort, in James's Bay, a considerable number of swans hatch ;—a few are killed by the natives there, who watch the game as it passes up and down narrow rivers communicating with the sea, and flowing from lakes of some magnitude scattered over the interior. In the winter months all the northern regions are deserted by the swans, and from November to April large flocks are to be seen on the expanses of the large rivers of the Oregon territory and California, between the Cascades Range and the Pacific, where the climate is particularly mild, and their favourite food abounds in the lakes and placid waters. Collected sometimes in great numbers their silvery strings embellish the landscape, and form part of the life and majesty of the scene. These societies break up as they advance upon their long spring journey to the north. They are then dispersed in small bands and but few together, each of a pair at last separating and betaking to the cares of the season of incubation. In the most secluded and unfrequented districts, where there is ample water range, they rear the young.

Superior to the swans as an article of food, the geese of every species are tenfold in number, and they form the favourite dish of the Indians of Hudson's Bay. When the long and dreary winter has fully expended itself and the Willow Grouse (*Tetrao saliceti*) have taken their departure for more northern regions, there is frequently a period of dread starvation to many of the natives, who are generally at that time moving from their wintering grounds to the trading posts. The first note, therefore, of the

large grey or Canada goose, (*Bernicla Canadensis,*) is listened to with a rapture known only to those who have endured great privations, and gnawing hunger. The melancholy visages brighten, and the tents are filled with hope, to which joy soon succeeds, as the happy father, or hopeful son and brother, returning successful from the hunt, throws down with satisfaction and pride the grateful load.

The *Bernicla Canadensis* here alluded to is the largest of our geese, and is almost always first seen in the Hudson's Bay Company's Territories. It may be only a single straggler which has lost its mate, or at most five or six together. These are the advanced guard of the serried legions of other water-fowl, which nature and instinct send forth every spring from the south, to occupy during the productive summer, the land of the north, and to partake of the plentiful and luscious repasts that Providence has, during their absence, been storing up for them, in a hidden, yet nascent state.

The Canada grey goose, as if aware of the general favor in which it is held, spreads itself diffusively over the whole continent. Its disposition has less of wildness in it than that of the snow goose. We come upon it hatching in quiet recesses and corners, surrounded by reedy waters, where "rushes and grasses do most abound." It is at home over the whole wooded portion of the country, equally so in the extensive marshes of the sea coast, and on the mossy barrens of the Chipewyan and Esquimaux lands. During the winter, like other species, it takes refuge in the more temperate portions of the country, courting always open water. I have seen a flock in the strong open current of the St. Lawrence, above Lachine, near Montreal, in the month of January or February, but such an occurrence is rare. In this latitude, say 45° west of the Rocky Mountains, but especially on the coast of the Pacific, they are plentiful during the whole winter, in mild seasons. Before Oregon was settled by the Americans, the Hudson's Bay Company's post of Fort Vancouver used to be supplied by Indian hunters with grey geese, large and small, as well as with occasional swans and white geese; and this at times so liberally, that a day's rations twice a week could be furnished to an establishment of 30 to 40 men. Some of these geese had been killed by the bow and arrow. This game formed our best rations, but it was seldom in such condition as it is to be had in the north, after it has enjoyed a week or two on the feeding grounds. I have no

doubt that the great mass of the grey geese pass their winter to the south of the Platte waters, in the swamps of Florida and the Lower Mississippi, and on the waters of the western side of the continent, towards their outlets into the Pacific. Now that the rifle and fusee have been introduced so plentifully into California and Oregon, it is to be feared that the numbers of the larger wild fowl will decrease rapidly. The bow and arrow formerly thinned them considerably ; now the gun, with an increasing population, will have more fatal effect.

The lesser grey goose, (*Bernicla Hutchinsii*,) arrives in subarctic regions later than the other, and about the same time or shortly before the snow goose, (*Anser hyperboreus.*) They are shot occasionally in the interior when they alight, and in considerable unmbers at Albany, and elsewhere along the coast of James's and Hudson's Bays. Unlike the large grey goose, it can scarcely be said that they incubate in a scattered and detached manner over the whole extent of the wooded country. They rather proceed in large and united bands, keeping a lofty flight, and making few stoppages until they reach the coast. On arrival there, about the beginning of May, they immediately commence feeding in the salt marshes, on the soft white rooted grasses, continuing to do so for a fortnight or three weeks, and at last becoming quite plump, and capital subjects for the table. When fully in good plight, they take their departure for more arctic regions, at nearly the same time as the snow geese, not to appear again until they return with their young broods in the month of September. These smaller grey geese are killed in fewer numbers than the larger species, on their passage to Hudson's Bay, which may be accounted for by their higher and more continuous flight, but once they settle upon their feeding grounds the tables turn upon them, and the slaughter committed in their ranks is wonderful, and would sate the greatest Nimrod that ever waded swamp.

The Brant goose (*Bernicla Brenta*,) the Calliwappemaw of the coast Crees, is but little looked after or cared for in Hudson's Bay, being a small species, keeping out to sea on the shoals, and towards lowest watermark, and affording a dish not in high estimation. Their arrival in the north is later than most of the waders and palmipedes.

The snow goose, (*Anser hyperboreus*,) although it plays a less conspicuous part in the interior of the country, where it seldom alights except along the margins of the larger lakes and streams,

becomes, from its consolidated numbers, the first and greatest object of sport after the flocks alight in James's Bay. The havock spread throughout their ranks increases as the season advances, and their crowds thicken, and even the Indian becomes fatigued with the trade of killing. In the fall of the year, when the flocks of young "wewais" or wavies as they are called are numerous and on the wing between the low tide mark and the marshes, or are following the line of coast southerly, it is no uncommon occurrence for a good shot, between sunrise and sunset, to send to his lodge above a hundred head of game. In such cases the hunter is stationed in what is called a stand—a space from four to five feet square, enclosed by willow twigs and long grass stalks—from which he fires, with forms of geese or "decoys" set up a short distance in his front. The geese fly towards these, when he gives out their peculiar call, and frequently he has his wife or son, or grown-up daughter, to load the discharged gun for him, while he fires with the loaded.

These wavies or white geese form the staple article of food, as rations to the men in James's Bay, and are the latest in leaving the coast for southern climes—an event which takes place towards the end of the month of September, although some weak broods and wounded birds linger behind until the first or second week in October. They are deliberate and judicious in their preparation for their great flight southwards, and make their arrangements in a very business-like manner. Leaving off feeding in the swamps for a day or more, they keep out with the retreating ebb tide, retiring, unwillingly as it were, by steps at its flow, continually occupied in adjusting their feathers, smoothing and dressing themselves with their fatty oil, as athletes might for the ring or race. After this necessary preparation the flocks are ready to take advantage of the first north or north-west wind that blows, and when that sets-in, in less than 24 hours the coast that had been covered patch-like by their whitened squadrons, and wildly resonant with their petulant and incessant calls, is silent as the grave —a deserted, barren, and frozen shore.

The friendly intercourse that exists between these geese and the blue wavies, (*Anser* or *Chen cœrulescens*) has induced some to suppose that they were merely varieties, which is a mistake. The young white wavies arrive from the north with their parents without mixture of other geese, and they have nearly the same white garb as the old birds, but with their heads of a dirty red-

dish tinge, exactly as if they had been rubbed by the hair-dresser with the red rust of iron; and the bill, as is always the case with the young of the feathered race, is tender, soft, and compressible. On the other hand the *A. cœrulescens* comes down upon the Eastmain coast, also in perfectly distinct flocks, the young of a more diffused blue colour, as well as being of smaller size. The full-grown blue wavy is besides somewhat larger than the white, and has its flesh most decidedly of a much fairer hue. In the spring, James's Bay is frequently crossed by both species, as far north as Capes James and Henrietta Marie, and occasionally two or three of the blue may be observed in a large flock of the white on the Albany or west shore. White again are seen mixed up to a certain extent with the full flocks of blue on the Eastmain. This is not singular, their cry being almost the same and their habits similar, and they are, it must be allowed, closely allied species.

According to Indian report, a great breeding ground for the blue wavy is the country lying in the interior of the north-east point of Labrador, Cape Dudley Digges. Extensive swamps and impassable bogs prevail there; and the geese incubate on the more solid and the driest tufts dispersed over the morass, safe from the approach of man, or any other than a winged enemy. Neither fox nor wolverine can penetrate to them, nor pass over the deceitful quick bogs to disturb their quiet.

The *Anser Gambelii*, or white fronted goose, called by some the laughing goose, is seldom seen in the southern part of Hudson's Bay. At York Factory they are less rare, but at Churchill frequent enough. I am disposed to believe that this goose is more an inhabitant of Central and Western America during the winter months than of the eastern board. Proceeding northwards, therefore, in the end of April and early part of May, it comes upon the coast of Hudson's Bay towards York Factory, and is scarcely seen in James's Bay. I have not been able to ascertain whether any detachments are met with on the Atlantic coast of Labrador. Do they not feed on the productions of dry downs, and barren and rocky country, in preference to the swamp grasses and algæ? On the Lower Columbia, and in Oregon or the Willamette valley, they abound with other geese, sometimes in nearly equal proportions, and the snow goose still delighting to keep the sea coast, while the *A. Gambelii* and the grey geese take to the rivers and lakes of the interior. These are seldom frozen to the southward of latitude 45°, and very severe weather only

requires from this kind of game in that quarter a slight removal of one or two degrees to the southward.

Of all the geese I have enumerated, the *Anser cœrulescens*, or blue wavy, appears to be the least known in the settled and civilized portions of North America. In May it frequents only James's Bay and the Eastmain of Labrador, and it is probably the case that its hatching ground is on the north-west extremity of that peninsula, and the opposite and scarcely known coast of Hudson's Straits. In the autumn their bands, increased six or sevenfold by the young, return by the same route, but where they winter is the query. I have not seen them on the Columbia nor on the north-west coast. Do they adopt the seaboard on a lower latitude? Are they to be found in winter retreat in Southern California and Mexico?

It is very difficult to form anything like an accurate idea of the numbers of the various species of geese that have just been passed under review. Of the quantity shot at particular points where they become an article of provisions, we may arrive at a wide but still a better estimate. Seventeen to twenty thousand geese are sometimes killed by the Albany Indians in the autumn or fall of the year, and ten thousand or more in the spring, making a total

for these coast Crees alone of at least	30,000
Not speaking so certainly of other natives, I would place the Moose Indians as killing at all seasons	10,000
Rupert's River natives	8,000
Eastmain and to the north, including Esquimaux.........	6,000
The Severn coast I cannot compute as yielding less than.	10,000
The York Factory and Churchill Indians, with Esquimaux beyond, must dispose of........................	10,000
Making a total of geese killed on the coast of...........	74,000

As many geese must die wounded, and others are got hold of by the foxes and wolverines, we may safely allow the total loss to the flocks while running the fiery gauntlet as equivalent to 80,000. I was at one time inclined to believe that two-thirds of this number was, or might be, the proportion for the autumn hunt, but it is probably nearer three-fourths, and we have thus 60,000 in round numbers brought down from the newly-fledged flocks, as they pass southernward along the bay. I have lately been informed by an old and experienced hunter, that he believes that for every goose that is killed, above twenty must leave the bay without

scaith, as although there is sometimes destruction dire among some lots that approach the gun, and that feed in quarters frequented by hunters, yet innumerable families of them alight on remote and quiet feeding ground, remain there unmolested, and take wing when the cold sets in, with their numbers intact. I must allow the correctness of this remark, and the deduction to be drawn from it is, that 1,200,000 geese leave their breeding grounds by the Hudson's Bay line of march for the genial south. Of the numbers to the westward along the arctic coast, that wend their way to their winter quarters straight across the continent, we can form but a very vague opinion, but computing it at two-thirds or more of the quantity supposed to leave the eastern part of the arctic coast, we cannot have less than two millions of geese, composing the numerous battalions which pass over the continent between the Atlantic and the Rocky Mountains, borne aloft generally like the scud, and as swiftly hastened on, by the force of the boreal blast.

I ought to observe that the Brant geese, *Bernicla Brenta*, are not included in the above estimate. They are pretty numerous on the Atlantic coast, but are quite neglected by the Indians in general of Hudson's Bay.

Two small species of south-west habitat, the *Dendrocygna Autumnalis* and *D. fulva* never come north, as far as I know. I have never seen the first, but have shot one out of a pair of the latter on the banks of the Columbia, above Okanagan. This I daresay is usually its limit to the north, and I believe it has never been seen to the eastward of the great stony ridge. Neither of these elegant little geese ever visit Hudson's Bay.

ARTICLE XXV—*On the occurrence of Graptolites in the base of the Lower Silurian.* By E. BILLINGS, F.G.S., Geological Survey of Canada.

In an excellent work upon the Lower Silurian rocks of *Ehstland* in Russia, by M. FRIEDRICH SCHMIDT,* the following groups are made out and well authenticated by copious lists of fossils from every division.

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* *Untersuchungen über die Silurische Formation von Ehstland Nord-Livland und Oesel.* Von Mag. FRIEDRICK SCHMIDT. 8vo. pp. 250. With maps. Dorfrat, 1858.

	EHSTLAND.	NORTH AMERICA.
Zone 3.	3. Borkholm'sche Schicht.	These six divisions represent the Lower Silurian of North America from the base of the Chazy to the top of the Hudson River group.
Zone 2.	2, a. Lyckholm'sche Schicht 2. Wesenberg'sche Schicht.	
Zone 1.	1, b. Jewe'sche Schicht. 1, a. Brandschiefer. 1. Vaginatenkalk.	
Lowest fossilliferous rocks of Russia	Chloritische Kalk. Thonschiefer. Grünsand. Ungulitensandstein. Blauer Thon.	The Chloritische Kalk holds *Orthides* allied to those of Point Levi. The Thonschiefer graptolites like those of Norman's kill near Albany.

There is little doubt but that Schmidt's Zones, 1, 2, 3 are the equivalents of all the North American rocks from the base of the Chazy limestone to the top of the Hudson River. Schmidt, Eichwald and others have lately greatly added to the number of species in these rocks. In the lists of fossils given by Schmidt in the work cited there are thirty-one species recognized as occurring in the Lower Silurian of America from the Chazy upwards. None of them occur below the Vaginatenkalk in Russia, and none of them below the Chazy in America. In Ehstland the Cystidean *Sphæronites Leuchtenbergii* or *S. pomum* occurs in (1). *Echinosphærites aurantium* in (1), and *E. aranea* in (1). These represent the American Chazy genera *Malocystites* and *Palæocystites.* The genus *Bolboporites* is confined to (1) in Ehstland and to the Chazy in Canada. The genus *Illænus* is most abundant in both countries in the same formations. Of the two Russian species of *Maclurea*, one is found in (1) and the other in (2, a). *Ecculiomphalus Scoticus* occurs in (1), and *E. septiferus* in (1, a)

The Orthoceratites, with large lateral siphuncles, also abound more in the base of the Russian limestones than in the upper strata. Taking all these facts together it seems highly probable that Schmidt's No. 1 represents the Chazy and Black River of North America.

The "Chloritische Kalk," or Chloritic limestone, seems to represent the Calciferous sandrock in part. This rock consists of a calcareous sandstone, with green grains and small globular

concretions. In some localities such as at Reval, Pöddis, Chudleigh, and Narwa, it becomes a magnesian limestone.

In lithological characters it therefore resembles the Calciferous sandrock, which, in the western or undisturbed portion of Canada, abounds in magnesian strata; and in the eastern, where it is expanded to a great thickness by the addition of slates and sandstones holds much chlorite where partially metamorphosed. The fossils cited by Schmidt are *Orthis calligramma*, *O. extensa*, *O. parva*, *O. obtusa*, *Orthisina plana*, *Rhynconella nucella*, and fragments of trilobites of the genera Illænus and Asaphus. In the limestones of Point Levi and Phillipsburgh we have three species scarcely distinguishable from *O. parva*, *O. obtusa*, and *O. plana*. So far as we can judge from external characters *R. nucella* is a *Camerella*, differing from *C. calcifera* in having the beaks closely incurved. The aspect of the Calciferous Brachiopods, so far as they are known, is more like that of the same group of fossils in the Chloritic limestone of Russia than that of any other formation.

The THONSCHIEFER or clay slate lying next below the Chloritic limestone is for us a most interesting formation, as it proves that in Russia there is (in or near the horizon of the Calciferous Sandrock) a ZONE OF GRAPTOLITES. It is described as a bituminous clay-slate, or alum-slate, with no fossils except traces of *Obolus* and an abundance of graptolites. Of these latter Schmidt identifies the following:

Graptolithus Sedgewickii. (Portlock.)
G. serratulus. (Hall.)
Dictyonema flabelliformis. (Eichwald.)

It is not easy to identify species of graptolites, but with respect to the above it should be borne in mind that *G. serratulus* is a remarkable form consisting of two stipes diverging at an obtuse angle; and so Schmidt describes the Russian specimens. In New York it occurs at Norman's kill, associated with another species of the same type *G. divaricatus*. (Hall.) Schmidt may be wrong as to the perfect identity of the species, but his description shows clearly that his specimens must belong to the same group of graptolites. *G. Sedgewickii* is found in Dumfrieshire in Scotland in the Lower Llandeilo slates, far below the horizon of the Hudson River Group. *D. flabelliformis* very closely resembles a Quebec species. Setting aside all questions as to the identity of the species, it is an interesting fact that a naturalist in Russia should find below rocks which represent the limestones of the upper half of the Champlain group, a

slate full of graptolites, at the same time, that evidence is accumulating in Canada, which tends to prove the existence of graptolitic slates associated with the Calciferous Sandrock.

On comparing the Lower Silurian of England with that of America, it is found difficult to point out in the vast column of the British strata, the horizon representing the base of the limestones of the Champlain group. All that can be said on this question is, that there are about twenty species of fossils common to the Lower Silurian of the two countries, and that they all occur in England in the upper half of the Llandeilo and in the Bala group. None of them are found in the lower half. The place of the Calciferous Sandrock would appear thus to be about half way down the immense depth of the Llandeilo formation. But graptolites are found far below this level in England. The Skiddaw slates for instance are described by Prof. Sedgewick, as, " A group of vast thickness, and probably admitting of several subdivisions. In some of its upper beds a few graptolites and fucoids have been found. Generally it is without a trace of fossils. It is the supposed equivalent of the Longmynd Slate, (1*a*) of the Cambrian series.* These slates appear thus to be of the age of the Lower Llandeilo. Yet they hold the following species of graptolites.

G. sagitarius. (Hisimger.)
G. tenuis. (Portlock.)
G. latus. (Mr. Coy.)

Associated with these are compound graptolites allied to species found at Quebec.† According to Prof Hall, *G. sagitarius* and *G. tenuis* are found at Norman's kill along with *G. serratulus* in slates which he considers to belong to the Hudson River group. I fancy that no British Geologist would think of placing the Skiddaw slates at the top of the Lower Silurian.

Again in the lowest slates of the Llandeilo, near the Stiper Stones in Shropshire *G. geminus*, *G. pristis*, and *G. Murchisonii* occur associated with *Theca simplex* (Salter), a species scarcely distinguishable from a *Theca* of which I have specimens from the *Dikellocephalus* sandstone of Wisconsin. These slates belong to the very base of the Lower Silurian, and repose upon the Lingula

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* British Palæozoic Fossils. Intr. p. xxi.

† See Salter's note " On new fossils from the Skiddaw Slates." Geologist, Vol. 4., p. 74.

Flags at the Stiper Stones, the true Primordial Zone as recognized in England.* *G. geminus* as I understand occurs in Sweden in the upper part of the Lower Silurian. *G. pristis* ranges through the whole formation in different countries, and I believe that *G. Murchisonii* has a similar extended vertical distribution. A species occurs in the slates of the Quebec group which is clearly allied if not identical with *G. geminus.* On comparing the works of the different authors it will be seen that other species are identified as having not only a great geological but a wide geographical range. It would appear thus that graptolites cannot always be relied upon to show that exposures of rock widely separated from each other are either of a different or of the same age.

In the Primordial Zone of Bohemia no graptolites have been discovered. Of the genus *Dictyonema* one species *D. sociale* (Salter) occurs in the *Lingula Flags* in England, but none of the ordinary graptolites have (unless very recently) been observed in that formation. In Sweden *Dictyonema flabelliformis* and a graptolite which Barrande says has "an appearance analogous to that of *G. pristis*" occurs in the slates of Andrarum, in Angelins Regio *B.* in the true Primordial Zone. It would appear from all this that graptolites are rare in the Primordial Zone and that they abound in every stage of the second Fauna being most numerous in slaty rocks and rare in limestones and sandstones.†

As to their value in identifying strata Barrande observes that as "in general they consist of forms very similar in appearance it is difficult to distinguish them especially when found in fragments. The study of the family is not sufficiently advanced to enable us to recognise with certainty among its types those which may characterise exclusively each one of the three faunæ of the Silurian."‡

I have prepared the above observations in order to show that the occurrence of graptolites in rocks so ancient as those of the Quebec group is not inconsistent with what we know of their geological range in other countries and consequently that we are not compelled to refer all the slates in which they are found in North America to the Hudson River group.

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* See Sir R. I. Murchison's 3rd Ed. of *Siluria*, pp. 39. 50.

† See Barrande's *Parallèle entre les dépôts Siluriens de Scandinavie et de Bohème*, p. 44. And also Angelins "*Palæontologia Scandinavica*," p. IV.

‡ *Documens anciens et nouveaux sur la fauna primordiale et le système Taconique en Amérique*, par M. J. Barrande, Bul. Geo. Soc. France. 2e Series, Vol. 18, p. 288.

ARTICLE XXVI.—*A short review of the Sylviadœ or Wood-Warblers found in the vicinity of Montreal.* By H. G. VENNOR.

(Presented to the Montreal Natural History Society)

Among the many families of birds visiting us during the summer months, and enlivening our woods and orchards with their songs, none are more interesting, agreeable, or useful than the subjects of our present review. Excepting the humming-bird, we find among them the most diminutive of the feathered tribes. Yet, small and insignificant as these tribes may seem to be, they are designed by Providence to fill an important sphere in Nature. If it were possible to strike them off the list, and to leave their post vacant, we would soon find out to our loss that a great blank existed. The chorus of our woods would have lost its charm, and would resemble a grand piece of music, with the lower-toned, and connecting notes taken away. Thus leaving disconnected strains, truly beautiful and sweet in themselves, but, by being disconnected, having lost their charm.

Who can stroll through our woods during spring without being struck by the grand chorus produced by many sweet-noted songsters? But, let him analyze this swelling chorus, and it will be found that the sweet warble of the tiny warblers connecting the rich notes of the tanager, red-bird, thrush, and robin, forms the gentle swell that is so pleasing. This, however, would only be a mere loss of music; worse effects would follow. Soon our groves and forests would have lost their green fresh looks, and our orchards would have ceased to bear fruit; and for this reason—there exist around all vegetation hosts of minute insects that, left unmolested, would soon spread devastation through the vegetable kingdom. Myriads of these insects fall a prey to the thrushes, flycatchers, and swallows, but myriads more lurk and lie concealed beneath the bark, and under the leaves of the trees where neither thrush nor flycatcher could reach them. To this post, or sphere of usefulness, the true warblers are confined. With their bills they probe every crack and crevice of the bark, with their quick eye they glance over and under every leaf.

Think of the amount of good accomplished by even one of these birds in the capture of a parent insect, ready to deposit its eggs; it at least equals the destruction of a thousand caterpillars. The following is the general form of bill:—Slender, straight, and awl shaped; higher than wide at the base, and furnished with bristles; lower mandible straight. It is curious to watch some of

these little birds when on first alighting they commence with the lower branches, and so course their way upward into the tree, searching every nook and corner as they run along. Every now and again by a gentle warble, he lets us know in what direction he is in. Their habits vary considerably in the different species, but in general they frequent woods, groves, and orchards, and subsist on the small insects found among the leaves and beneath the bark of the trees. Some writers have called the warblers a timid and retiring group, but we should say that what looks to be a timid hiding disposition is nothing more than an eager search after their food, in and out amongst the thick foliage of the trees. Instead of being timid, most of them are known to be of a bold and pugnacious disposition. Some of them are decked in the liveliest colors, while others are arrayed in sombre hues. The warblers in general make but a short stay in the Southern States on their way north to breed, so that little can be studied of their habits in that quarter. Here, however, we have abundant opportunity of watching their movements and manner of breeding. We also have a few warblers that pass us early in spring on their way to grounds further north, most of these breed partially here, but their proper breeding-places, as we have before stated, are farther to the north. In general their migratory movements are very quiet, swift, and seldom are observed.

Many of these birds are indeed charming songsters, but I think we may safely say that the majority have hardly any song; or at any rate only a few low notes uttered in a monotonous manner. These latter however are by no means to be despised, nor are their notes unpleasant. All the warblers are migratory here. When Spring with her genial breath has warmed into life the hosts of insects which have been dormant during the winter, Providence has wisely ordered the return of these birds to keep these insects in check; again in autumn when the insect tribes begin to diminish and no longer require to be kept in check, these useful birds speed their way to other climes.

Some of the flycatchers approach very near to the warblers in their general habits, seeming only to differ in shape of bill, that being the same as in the other species of flycatcher. In like manner the warblers in some of their species resemble the flycatchers in habits, but also differ in form of bill. For this reason there has been and still exists a great deal of difficulty in drawing a definite line between the warblers and flycatchers. Nature seems to

delight in joining her various tribes, by, as it were, intermediate species, thus beautifully and skilfully blending one form of structure with another. Audubon in his first genus of warblers, has classed together these intermediate forms, under the title of flycatching warblers. Of these we shall say something in the proper place.

The more we look into the habits of these little birds the more are we impressed with their adaptedness to their position. They are indeed an important wheel in the gigantic machinery of Nature. Audubon has divided this family into five genera, as follows :—

1st.	The	Flycatching warblers	....Myiodioctes.
2nd	"	Wood "	....Sylvicola.
3rd	"	Ground "	....Trichas.
4th	"	Swamp "	.....Helinaia.
5th	"	Creeping "	....Mniotilta.

These five genera include all the wood-warblers known. It is now ours to enumerate as far as possible the species that breed or only visit here. Perhaps it will be as well to state here that although we are only taking notice of the wood-warblers or true warblers, another family of warblers exists, which although differing materially from the one now before us yet partakes somewhat of its characters. I refer to Audubon's family Sylvianæ, which includes the genus Regulus or crested wrens, and the Sialia or blue-birds. It is sufficient here to state that both these genera are represented in this vicinity. But to return, the first group of wood-warblers which claims our attention is that of the flycatching wood-warblers. The birds of this group are very nearly allied to the flycatchers, in their manner of catching their prey, also somewhat in form of bill, but their other habits and general formation class them among the warblers. The Canada flycatching warbler (*Myiodioctes Canadensis*, Lath.) is the sole representative of this group, I think I may say, in Lower Canada. This is truly a northern warbler, never migrating south of Pennsylvania. The majority breed even farther north than Montreal or Quebec, and it is only in spring they may be seen around our mountain ; during the warm season they are never met with, and it is for this last reason I consider them to breed further north. However, it is only where the surrounding country is hilly, where the low woods or shrubbery grow in a tangled interwoven mass, where the trickle of the streamlet is heard as it flows laughingly amongst

the tall rank grass, that this warbler delights to dwell; there only, his nest may be seen suspended over the running brook, and his song, simple but not unmusical, heard in all its mellowness. Here he may be seen sitting beside his loved partner, and pouring into her ear notes of joy and love. Here, again, he is seen running along the branches, searching under every leaf, and into every crevice to secure some dainty morsel for his clamorous young. Sometimes he leaves the tree for an instant in pursuit of some favorite insect in the manner of a flycatcher. This flycatching warbler, truly seems to be as a link placed by Nature between the warblers and flycatchers; thus allowing no sudden change of form or habits. The migratory movements of this and indeed of all the warblers are very retiring and are seldom seen. This species has been seen in New Brunswick, Nova Scotia, Newfoundland, and also in the country of Labrador. In all of these places it seems likely it breeds.

Specific characters, (Wilson);—This species is four and a half inches long and eight in extent; front black; crown dappled with small streaks of grey and spots of black; line from nostril to around the eye yellow; below the eye a streak or spot of black descending along the sides of the throat, the breast being marked with a broad rounding band of black composed of large irregular streaks; black wings and tail cinereous brown; vent white; upper mandible, dusky; lower, flesh coloured; legs and feet the same; eye hazel. The female differs only in having the spots on the breast of a fainter hue.

The next group is much more largely represented in this neighbourhood, viz., the wood-warblers, birds of this genus are confined for the most part to the forests, orchards, hedges. They are in fact more useful to man than any of the other genera.

The Yellow-poll wood-warbler (*Sylvicola æstiva*, Wilson)—We have naturally taken this bird first, from its abundance, and also on account of its being so well known. Indeed we need only place its name on the list, without any remarks on its habits as they are so common.

It may be found in every garden in the city that is of any size, helping to rid the plants of vermin. Its nest may sometimes be found in the low bush, at others among the topmost branches of the maple, materials of nest generally flax, hemp, or cotton.

Among the many birds imposed upon by the cow-bunting is this little species, and it is remarkable the amount of ingenuity

displayed by it in baffling the purposes of its tormenter. According to Nuttall's account, this bird when a foreign egg has been deposited in her nest, at once builds a second flooring thus making two stories, the cow-bunting's egg with her own being buried in the lower story. She then lays her complement again, and generally proceeds without further molestation. But nests have been found three stories high thus showing her great perseverance. The following characters are all that are necessary. Color of the whole at first sight of a rich golden yellow, but the back is a little greenish, and the tips of the wings brown; length five inches; extent seven inches.

The Chestnut-sided Warbler (*Sylvicola ictrocephala*, Lath.) This delightful warbler, is one of the first seen in spring, as he darts in and out among the spreading branches of the bass-wood tree. Mountainous country is his favorite place of resort; seldom is he seen about orchards or gardens; being extremely shy, but not exactly timid. His notes resemble those of the preceeding species, but are not so loud. Among the many songsters on which nature has lavished her colours, few are there that can show a plumage as neat and diversified as that of the present species. He is more abundant during spring than at any other time; few individuals breed here. The front and top of our mountain is a favorite place of resort for this bird. It appears that Audubon ransacked the borders of Lake Ontario, and those of Lakes Erie and Michigan, without once meeting with this species. He gives very little account of its habits, as he so seldom met with it; nor could he find any person at that time, that was any more fortunate than himself. It is a pity that Audubon did not take a tour round in this direction, where he could have easily noted their habits.

Specific characters, (Wils.)—Length five inches, extent seven and three quarters. The front line over eye and ear feathers is pure white; upper part of the head, brilliant yellow; the lores and space immediately below, are marked with a triangular patch of black; the back and hind head is streaked with gray, dusky, black, and dull yellow; wings black; primaries edged with pale blue; coverts broadly tipt with yellow; secondaries, broadly edged with the same; tail, black, forked, and edged with ash; from the extremity of the black, at the lower mandible, on each side, a streak of deep reddish chestnut descends along the sides of the neck and under the wings, to the root of the tail; the rest

of the lower parts are pure white; legs and feet ash; bill, black; irides, hazel. Female, hind head much lighter yellow, and the chestnut on the sides is considerably narrower, and not of so deep a tint.

The Yellow-crowned wood-warbler (*Sylvicola cornata*, Lath.)—This is another lively and beautiful little warbler, and is, we are happy to state, a regular visitor to our island. Like the preceding, however, they are most numerous during spring, as they pass northward; a few breed in our mountain. Though most of the warblers are extremely unsocial in their habits, this is an exception; they may be seen flying from tree to tree in company, chattering, one to another, as they roam among the branches. As is the case with the majority of the wood-warblers, it prefers low shrubbery to the higher trees; sometimes, however, it may be seen skipping about among the blossoms of the maple tree, in search of its favorite insects. It fixes its nest generally on a branch a few feet from the ground. It is an expert fly-catcher, and also devours great numbers of caterpillars. This species and the preceding are truly useful scavengers in our woods and forests. It indeed very much resembles the fly-catchers. Wilson says: "Though the form of the bill of this bird obliges me to arrange it with the warblers, yet, in its food and all its motions, it is decisively a flycatcher." Seldom is it seen very deep in the woods; the roadside, the garden, and orchard, are his favorite resorts. They are by no means timid, but let you approach very close to them. Labrador seems to be a favorite summer resort for many of our warblers; this species breeds there abundantly. The nest is generally lined with feathers and hair. Their notes are not worthy the name of song, they are nothing more than a twitter, as they fly from bough to bough. The snapping of their bill may be heard at a considerable distance.

Specific characters, (Wilson.)—This species is five inches and a half long and eight inches broad; whole back, tail-coverts, and hind head, a fine slate colour, streaked with black; Crown, sides of breast, and rump, rich yellow; wings and tail black; the former crossed with two bars of white; the three exterior feathers of the latter spotted with white; cheeks and front, black; chin line over and under the eye, white; breast, light slate, streaked with black, extending under the wings; belly and vent, white; latter spotted with black; bill and legs, black.

The Bay-breasted wood-warbler, (*Sylvicola Castanea*, Wilson.) —This warbler is much rarer here than the preceding species, and very few individuals breed in our vicinity. It is very rare all through the U. S., and from all accounts must breed farther north. Likely thay breed in Newfoundland and Labrador. Low thickets and tangled shrubbery are favorite resorts of this species: sometimes they are to be seen running along fence-rails, searching every crevice and hole for their prey. This species, not being mentioned by any European naturalist, must be foreign to that continent.

Specific characters,(Wilson.)—Length of this species,five inches; extent, eleven; throat, breast, and sides under the wings, pale chestnut, or bay; forehead, cheeks, line over, and strip through the eye, black; crown, deep chestnut; lower parts, dull yellowish white; hind head and back, streaked with black, in a grayish buff ground; wings, brownish black, crossed with two bars of white; tail, forked, brownish black, edged with ash, the three exterior feathers marked with a spot of white in inner edges; behind eye is a broad oblong spot of yellowish white. Female has much less of the bay color on her breast. Bill, black; irides, hazel.

The black-poll wood-warbler, (*Sylvia striata*, Lath. and Wilson.)—We have now before us a plain plumaged, but neat bird. He seems, like the yellow-crown warbler, to hold an intermediate place between the flycatchers and warblers, having the manners of the former, and the form of bill of the latter. They are rare around this city. Thickets are their favorite breeding places, as they there find their favorite food, and are safe from all intrusion. It may sometimes be seen among the branches of the tallest trees, and while there, their notes are so low, that they can scarcely be heard from below. Labrador is again a favorite breeding place for this species. I have not heard of a specimen being shot for the last three years.

Specific characters.—Length, five and a half inches; extent, eight and a half; crown and hind head, black; cheeks, pure white; from each lower mandible runs a streak of small black spots; those on the side larger; the rest of the lower parts, white; the wing, black, edged with ash; first and second row of coverts, broadly tipt with white; back, ash, tinged with yellow ochre, and streaked laterally with black; tail, black, edged with ash, the three exterior feathers, marked on the inner webs with white;

bill, black above, whitish below, furnished with bristles at the base: iris, hazel; legs and feet, reddish yellow. Female differs very little from male.

The black-throated blue wood-warbler, (*Sylvicola Canadensis*, Lath. and Wilson.)—This delightful little warbler is exceedingly rare in Lower Canada. Although nothing of a songster, his colours are very bright and rich, and his plumage in general neat. A small chirp is all that is heard from him, as he flies from bush to bush. This warbler is seldom met with in our vicinity; one was shot here some four years ago, and I have not heard of any having been seen since. Our museum has a very good specimen of this rare bird. Certainly they do not breed here regularly, if at all, a stray individual may sometimes remain, to rear its brood on our mountain, but not often. Audubon traced this warbler, through the upper parts of the State of New York, into Maine, the British Provinces, and the Magdalen islands, in the bay of St. Lawrence. According to his account, the nest is usually placed on the horizontal branch of a fir tree, seven or eight feet from the ground; nest composed of slips of bark, mosses and fibrous roots, lined with fine grass, and an inner lining of feathers. When this warbler is feeding among the branches of a tree, one can hear quite distinctly the snapping of his bill, as he pursues the insects from twig to twig. He is extremely active, but as we have mentioned before, no real song. Not even during the pairing season, does his note become more musical. Before dismissing this interesting bird, I may be allowed to quote a few lines Wilson has written respecting it. He says:

"It is highly probable that they breed in Canada; but the summer residents among the feathered race, on that part of the continent, are little known or attended to. The habits of the bear, the deer, and beaver, are much more interesting to those people, and for a good substantial reason, because more lucrative; and unless there should arrive an order from England, for a cargo of skins of warblers and flycatchers, sufficient to make them an object worth speculation, we are likely to know as little of them hereafter, as at present."

Specific characters.—Length, four and a half inches; extent, seven and a half; the front and upper part of the head, is a fine verditer blue; the hind head and back, of the same colour, but not quite so brilliant; a few lateral streaks of black mark the upper part of the back; wings and tail, black, edged with sky

blue; the three secondaries next the body edged with white, and the first and second row of coverts also tipt with white; tail coverts, large black, also broadly tipt with blue, so as to appear nearly wholly of that tint; sides of the breast, spotted or streaked with blue; belly, chin, and throat, pure white; the tail is forked; the five lateral feathers on each side with each a spot of white; the two middle more slightly marked with the same; from the eye backwards extends a line of dusky blue; before and behind the eye, a line of white; bill, dusky above, light blue below; legs and feet, light blue. (Wilson.)

The black and yellow wood-warbler, (*Sylvicola maculosa*, Lath.)—Few of the warblers are so highly gifted as the species now before us. His varied and beautiful plumage, his sweet, soft warble, his lively habits, and his general usefulness, all tend to interest every beholder. He cannot be said to be common with us; some, no doubt, always breed here, but the majority go farther north. Low woods are his favorite resorts; there he may be heard singing to his beloved partner, from sunrise to sunset; there you may see his tiny nest. The motions of this bird are quick and interesting. Suddenly his song ceases, and he darts forth from the thick foliage of the maple, and remains poised, with quivering wings, before a cluster of blossoms, every now and again darting into them, after some favorite insect. Again he returns to the tree, and with spread tail and drooping wings commences his search among the leaves, seeming to try and show off his beauty to the best advantage. He makes no clicking sound with his bill, while feeding. His nest is always placed in the thickest part of the foliage, and is seldom seen. Audubon says the eggs are five, rather elongated, and white, with reddish spots on the larger end. Our Museum of Natural History contains a good specimen of this pretty species.

Specific characters.—Length, five inches; extent, seven and a half inches; front, lores, and behind the ear, black; over the eye, a fine line of white, and another small touch of the same immediately under; back, nearly all black; shoulders, thinly streaked with olive; rump, yellow; tail coverts, jet black; inner vanes of the lateral tail feathers, white, to within half an inch of the tip, where they are black; two middle ones, wholly black; whole lower parts, rich yellow, spotted from the throat downwards with black streaks; vent, white; tail, slightly forked; wings, black, crossed with two broad transverse bars of white; crown, fine ash; legs, brown; bill, black. Female like male, but smaller.

The Blackburnian wood-warbler, (*Sylvicola Blackburniæ*, Lath.)—A person seeing this little warbler engaged among the branches securing his food, would at first sight take him for the American redstart, as he much resembles this little flycatcher in his movements among the branches.

Perhaps as you stand by you see him emerge from the thick foliage of some tree after a fluttering insect; he returns, and for a time you lose sight of him, but soon again your eye is attracted to another spot by his bright colour, and there he is, running in and out among the branches, prying into every crevice and hole, that may be in the branch. On first hearing his song you will not believe that the notes you hear proceed from that small orange coloured bird high up among the branches, so loud are they in comparison with his size. His notes are five or six in number. It is rare in Lower Canada, not so much so in Upper Canada. This warbler is found in Labrador and Newfoundland. Its nest has been found in this last mentioned place, but it likely breeds in both places.

Specific characters.—"Length, four and a half inches; extent seven inches; crown, black, divided by a line of orange; the black again bounded on the outside by a stripe of rich orange passing over the eye; under the eye, a small touch of orange yellow; whole throat and breast, rich fiery orange, bounded by spots and streaks of black; belly, dull yellow, also streaked with black; vent, white; back, black, skirted with ash; wings the same, marked with a large lateral spot of white; tail, slightly forked; the interior vanes of the three exterior feathers white; checks, black; bill and legs, brown; the female is yellow where the male is orange; the black streaks are also more obscure and less numerous." Wilson.

The pine-creeping wood-warbler, (*Sylvicola pinus*, Wilson and Lath.)—This trim little warbler seems nearly allied to the certhial-creepers; he is generally known as the creeping warbler. Like the creepers it may often be seen ascending the larger branches of trees, scraping and hopping against the bark to frighten out the lurking larva. It is only where pine trees abound that this warbler may be seen in any great numbers. They prefer lowlands to mountainous countries. For this and other unknown reasons, they are seldom met with in this neighbourhood. In the western Province they are not rare. The Museum of Natural History here, contains a very neat specimen of the male

bird. I believe he was shot here some time ago. Sometimes they pursue insects on the wing, but only as an exception to the general rule. This species differs from the majority of the warblers, in flying and associating in flocks. As far as we can learn, they have not been seen at Newfoundland nor Labrador. The Southern States seem to be their general breeding ground. The following is from Wilson: "The food of these birds is the seeds of the pitch pine, and various kinds of bugs. The nest according to Mr. Abbot, is suspended from the horizontal fork of a branch, and formed outwardly of slips of grape-vine bark, rotten wood, and caterpillars' webs, with sometimes pieces of hornets' nests interwoven; and is lined with dry pine leaves, and fine roots of plants. The eggs are four, white, with a few dark brown spots at the great end."

Specific characters.—"Length, five and a half inches; extent, nine inches; the whole upper parts are of a rich green olive; throat, sides and breast, yellow; wings and tail, brown with a slight cast of blueish; tail, forked; middle of the belly and vent feathers, white. The female is brown, tinged with olive green on the back; breast, dirty white, or slightly yellowish. The bill in both is truly that of a warbler, and the tongue slender, as in the Motacilla genus, notwithstanding the habits of the bird." Wilson.

The genus Trichas or ground-warbler, is represented here by two species only. Their habits are very retiring and secret; so much so, that their migratory movements are seldom noticed. Swampy land and tangled thickets are their places of resort; seldom are they seen higher than the top of a low bush, but often down among the roots and lower branches. In such situations they quietly but actively pursue their avocations. The nest is placed near the ground, and generally amongst the tangled roots.

The Mourning ground-warbler, (*Sylvicola Philadelphia*, Wilson.)—It is to be regretted that so little is known concerning this beautiful little bird's habits. He is very retiring but not timid; lives and rears his little family in low swampy marshes. As an exception, I have found him sometimes on our mountain, near a swamp at the east end. I have also seen the young birds on the mountain, and know they breed there. Few birds are more beautiful in respect to plumage, yet in song he decidedly ranks as inferior to most of the warblers.

Specific characters.—"Length, five inches; extent, seven; the whole back, wings and tail, are of a deep greenish olive; the tips of the wings, and the centre of the tail feathers excepted, which are brownish; the whole head is of a dull slate colour; the breast is ornamented with a singular crescent of alternate transverse lines of pure glossy white, and very deep black; all the rest of the lower parts are of a brilliant yellow; the tail is rounded at the end; legs and feet, a pale flesh colour; bill, deep brownish black olive, lighter below; eye, hazel." Wilson. The other species is the Maryland ground-warbler, (*Sylvicola Trichas*, Lath.)—It is to be found in the same situations as the former species. Its simple note may be heard among the tangled shrubbery of low watery situations. The nest is formed in the ground among the roots of the bushes; this it arches over, leaving a small hole for an entrance; the eggs are five, white, with touches of reddish brown. It seems to be pretty common through all the United States. Around the swampy thickets of Maryland it is exceedingly abundant. The only place in the vicinity of our city in which I have seen this bird, is a small bushy swamp on the Lachine railway, beside the aqueduct road. In this place they breed, returning south as early as the middle of August. They only raise one brood here. Insects and larvæ are their general food. The song or rather the notes of this bird are confined to a simple but not disagreeable twitter.

Specific characters.—"Length, four and three quarter inches; extent, six and a quarter inches; back, wings and tail, green olive, which also covers the upper part of the neck, but approaches to cinereous on the crown; the eyes are inserted in a band of black, which passes from the front on both sides, reaching half way down the neck; this is bound above by another band of white, deepening into light blue; throat, breast and vent, brilliant yellow; belly, a fainter tinge of the same colour; inside coverts of the wings also yellow; tips and inner vanes of the wings, dusky brown; tail, cuneform, dusky, edged with olive green; bill, black, straight, slender, of the true motacilla form, though the bird itself was considered as a species of thrush by Linnæus, but removed to the genus motacilla by Melin; legs, flesh-coloured; iris of the eye, dark hazel. The female wants the black band through the eye, has the bill brown, and the throat of a paler yellow." Wilson.

The fourth genus *Helinaia* or Swamp-warblers, is represented

here by a single species. Indeed I was about setting it down as having no representatives here, when I accidentally fell upon this little species. It is the Nashville swamp-warbler, (*Sylvia rubricapilla*, Wilson.) This is a beautiful and interesting little bird; rare in our neighbourhood. Like the birds of the last genus, they are found only in low swampy grounds, and feed in much the same manner. The point of difference between the two genera, is chiefly in the form of bill, which in the present genus is much longer and of a slenderer form. A few years ago the Nashville warbler was not so rare on our mountain as at present. His notes are very singular, much resembling the breaking of small twigs. The female I have never seen, nor have their nests ever been discovered here. The specimens shot by Wilson were procured near Nashville.

Specific characters.—"Length, four inches and a half; extent, seven inches; the upper parts of the head and neck, light ash, a little inclining to olive; crown, spotted with deep chestnut in small touches; a pale yellowish ring round the eye; whole lower parts, vivid yellow, except the middle of the belly, which is white; back, yellow olive, slightly skirted with ash; rump and tail coverts, rich yellow olive; wings, nearly black, broadly edged with olive; tail, slightly forked, and very dark olive; legs, ash; feet, dirty yellow; bill, tapering to a fine point, and dusky ash; no white on wings or tail; eye, hazel." Wilson.

The fifth genus *Meriotilla* or creeping-warblers, contains only one species, and it is very abundant with us during spring. The term creeping, explains the difference between this and the preceding genera. This species is the black and white creeper, (*Sylvia varia*, Lath.) A person who is taking an early stroll over the brow of our mountain, on a spring morning, cannot but help hearing often repeated a sharp twee-a-twee-a-twee, which from its singular shrillness strikes his attention. Looking round to try and discover the creature which emits these sounds, he sees descending the large trunk of a tree, a small bird of striped plumage, and busily engaged in gleaning the bark of all injurious insects. Seldom is this bird seen among the smaller branches of the tree, but nearly always on the large branches and trunks. Its tongue is beautifully adapted to its purpose, being long and horny, and of course, therefore, better fitted for extracting insects from beneath the bark of trees than for excelling in song; "as the hardened hands of the husbandman are better suited for clearing

the forest or guiding the plough, than dancing among the keys of a piano-forte. Which of the two is the most honourable and useful employment is not difficult to determine. Let the farmer, therefore, respect this little bird for its useful qualities, in clearing his fruit and forest trees from destructive insects, though it cannot serenade him with its song."

A beautiful account of this little species may be found in Audubon's works.

Specific characters.—" Length, five and a half inches; extent, seven and a half inches; crown, white, bordered on each side with a band of black, which is again bounded by a line of white passing over each eye; below this is a large spot of black covering the ear feathers; chin and throat, black; wings, the same, crossed transversely by two bars of white; breast and back, streaked with black and white; tail, upper, and also under coverts, black, edged and bordered with white; belly, white; legs, and feet, dirty yellow; hind claw the longest, and all very sharp pointed; bill, a little compressed sidewise, slightly curved, black above, paler below; tongue, long, fine pointed, and horny at the extremity." Wilson.

The female has not the black on the throat.

ARTICLE XXVII.—*Additional notes on Aboriginal Antiquities found at Montreal.*

(*Read before the Natural History Society of Montreal.*)

Since the publication of my former paper on this subject,* the excavations on the site of the ancient Indian village, described in that paper, have proceeded to completion, and now the whole of the superficial layer of sand having been removed, the spot has forever lost its original contour and appearance, and little probability remains of farther discoveries. Throughout the past year the progress of the work has been carefully watched, and special excavations have been made in the more promising places. By these means many additional objects have been obtained, some of them of much interest. Mr. E. Murphy, of this Society, has also aided in the work of exploration, and has accumulated a large collection; and I am indebted to Mr. Dand, the overseer in

* Canadian Naturalist, vol. 5, p. 430.

charge of the workmen, for several specimens, as well as for pointing out some of the more interesting spots for exploration.

The additional facts obtained do not induce me in any way to modify the statements of my former paper respecting the certainty of this having been the site of an ancient Indian village, and probably of that mentioned by Cartier under the name of Hochelaga. These conclusions are indeed strengthened by the observations more recently made.

The space in which the remains occur extends from Mansfield Street to a little west of Metcalfe Street in one direction, and in the other from a little south of Burnside Place to within 60 yards of Sherbrooke Street. In this limited area, not exceeding two imperial acres, twenty skeletons have been disinterred within twelve months, and the workmen state that many parts of the ground excavated in former years was even more rich in such remains. Hundreds of old fire places, and indications of at least ten or twelve huts or lodges have also been found, and in a few instances these occur over the burial places, as if one generation had built its huts over the graves of another. Where habitations have stood, the ground is in some places to the depth of three feet, a black mass saturated with carbonaceous matter, and full of bones of wild animals, charcoal, pottery, and remains of implements of stone or bone. Farther, in such places the black soil is laminated, as if deposited in successive layers on the more depressed parts of the surface. The length of time during which the site was occupied, is also indicated by the very different states of preservation of the bones and bone implements; some of those in the deeper parts of the deposit being apparently much older than those nearer the surface. Similar testimony is afforded by the great quantity and various patterns of the pottery, as well as by the abundance of the remains of animals used as food, throughout the area above mentioned.

All these indications point to a long residence of the aborigines on this spot, while the almost entire absence of articles of European manufacture in the undisturbed portions of the ground, implies a date coeval with the discovery of the country. The few objects of this kind found in circumstances which prevented the supposition of mere superficial intermixture, are just sufficient to shew that the village existed until the appearance of Europeans on the stage. Other facts bearing on these points will appear in

the course of the following detailed notice of the objects found since the publication of my former paper.

1. *Human Remains.*—Several additional skulls have been disinterred, but many of them in a state too fragile for preservation. All are of the same type of cranial conformation with those previously described. The measurements of five of the most perfect are as follows:—

	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
Longitudinal diameter,...	$6\frac{3}{4}$ in.	7 in.	$7\frac{1}{4}$ in.	$8\frac{1}{4}$ in.	7 in.
Parietal " ...	$5\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{8}$	$5\frac{3}{4}$	$5\frac{3}{4}$
Frontal " ...	$4\frac{5}{8}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{3}{4}$	$4\frac{1}{2}$
Vertical " ...	$5\frac{1}{10}$	$5\frac{3}{4}$	$5\frac{1}{2}$	$5\frac{5}{8}$	$5\frac{1}{2}$?
Intermastoid arch,........	$11\frac{3}{4}$	12	—	$14\frac{1}{4}$	12 ?
Intermastoid line,........	5	5	—	$5\frac{3}{4}$	—
Occipito-frontal arch,....	$13\frac{1}{2}$	$13\frac{3}{4}$	$14\frac{1}{2}$	$15\frac{1}{2}$	$13\frac{1}{2}$
Horizontal circumference,.	$19\frac{1}{2}$	20	$20\frac{1}{4}$	22	20

No. 4 is in Mr. Guilbault's collection. The others are in my possession. Nos. 5 and 6 belonged to a female and male skeleton buried together.. They have the Wormian bones largely developed, which is not the case with the others. No. 8 is remarkable for a lateral distortion which seems in part to have existed during life, but must have been increased by the pressure of the soil after the decay of the soft parts.

I have been very desirous to ascertain if the measurements of the skulls were capable of throwing any light on the question of the particular Indian race to which these people belonged. Prof. Wilson of Toronto, has kindly furnished for the purposes of this comparison, the following table, presenting the average measurements of about forty Huron skulls, and of about thirty believed to be Algonquin.

	Huron.	Algonquin.
Length,......	7.37 inches.	7.23 inches.
Breadth,.....	5.47 "	5.58 "
Height,.........	5.42 "	5.37 "

From this it would appear that the Algonquin skull is shorter, broader and lower than that of the Huron. The measurements of skulls from Hochelaga, given in this and my previous paper, present so great diversities among themselves, that any comparison with the averages above stated would seem impossible. Nos. 3, 4 and 8, approach very nearly to the Algonquin type; Nos. 6 and 7 to the Huron. No. 7 is remarkable for its length, and contrasts in

this respect very strongly with No. 4. Either the cranial type of the Hochelaga tribe presented within itself much greater diversities than those indicated by Prof. Wilson's averages, or the individuals whose remains have been found, belonged to more than one tribe. In either case a much larger number of skulls would be required to give satisfactory data for comparison; and it would then perhaps be possible to eliminate abnormal forms and those which might be of foreign origin. Nor must the consideration be omitted, that in a central locality, at the confluence of two great rivers, and at a time when Hochelaga may have been the point of union of various tribes, giving way before the inroads of the Iroquois and Hurons, its population may have been of a very mixed character.

The following remarks on the deformed skull noticed above, are from a paper by Dr. Wilson, in the *Canadian Journal* of September:

"In an interesting paper on "Aboriginal Antiquities recently discovered in the Island of Montreal," published by Dr. Dawson in the "*Canadian Naturalist*," he has given a description of one female and two male skulls, found along with many human bones, at the base of the Montreal Mountain, on a site which he identifies with much probability, as that of the ancient Hochelaga, an Indian Village visited by Cartier in 1535; and which he assigns on less satisfactory evidence to an Algonquin tribe. Since the publication of that paper, my attention has been directed by Dr. Dawson to two other skulls, a male and female, discovered on the same spot, both of which are now in the Museum of McGill College, Montreal. One of these furnishes a still more striking example of a cranium greatly altered from its original shape subsequent to interment. It is the skull of a man about forty years of age, approximating to the common proportions of the Iroquois and Algonquin cranium, but with very marked lateral distortion, accompanied with flattening on the left, and bulging out on the right side. There is also an abnormal configuration of the occiput, suggestive at first sight, of the effects produced by the familiar native process of artificial malformation. This tends to add, in no slight degree, to the interest which attaches to the investigation of such illustrations of abnormal craniology; as the occurrence of well established examples of posthumous deformation among crania purposely modified by artificial means exhibits in a striking manner the peculiar difficulties which complicate the

investigations of the naturalist when dealing with man. The evidence which places beyond doubt the posthumous origin of the distorsion in this Hochelaga skull is of the same nature as that which has already been accepted in relation to an example recovered from an Anglo-Saxon cemetery at Stone, in Buckinghamshire. The forehead is flattened and greatly depressed on the right side, and this recedes so far, owing to the distorsion of the whole cranium, that the right external annular process of the frontal bone is nearly an inch behind that of the left side. The skull recedes proportionally on the same side throughout, with considerable lateral development at the parietal protuberance, and irregular posterior projection on the right side of the occiput. The right superior maxillary and malar bones are detached from the calvarium, but the nasal bones and the left maxillary remain in situ, exhibiting, in the former, evidence of the well developed and prominent nose characteristic of Indian physiognomy. The bones of the calvarium, with one slight exception, have retained their coherence, notwithstanding the great distorsion to which it has been subjected, though in this example ossification has not begun at any of the sutures. The exception referred to is in the left temporal bone, which is so far partially displaced as to have detached the upper edge of the squamous suture. Part also of the base of the skull is wanting.

"The posthumous origin of the distorsion of this skull is proved beyond dispute on replacing the condyles of the lower jaw in apposition with the glenoid cavities, when it is found that, instead of the front teeth meeting the corresponding ones of the upper maxillary, the lower right and left incisors both impinge on the first right canine tooth, and the remaining teeth are thereby so displaced from their normal relation to those of the upper jaw, as to preclude the possibility of their answering the purpose of mastication—which their worn condition proves them to have done,—had they occupied the same relative position during life.

"The extreme distorsion which this skull has undergone is still more apparent when looking on it at its base. The bone has been fractured, and portions of it have become detached under the pressure, while the mastoid processes are twisted obliquely, so that the left one is upward of an inch in advance of the right.

"The circumstances under which this Indian skull was found tend to throw some light on the probable process by which its posthumous malformation was effected. It was covered by little

more than two feet of soil, the pressure of which was in itself insufficient to have occasioned the change of form. The skull, moreover, was entirely filled with the fine sand in which it was embedded. If, therefore, we conceive of the body lying interred under this slight covering of soil until all the tissues and brain had disappeared, and the infiltration of fine sand had filled up the hollow brain-case; and then, while the bones were still replete with the animal matter, and softened by being filled with moist sand and embedded in the same, if some considerable additional pressure, such as the erection of a heavy structure, or the sudden accumulation of any weighty mass, took place over the grave, the internal sand would present sufficient resistance to the superincumbent weight, applied by nearly equal pressure on all sides, to prevent the crushing of the skull or the disruption of the bones, while these would readily yield to compression of the mass as a whole. The skull would thereby be subjected to a process in some degree analogous to that by which the abnormal developments of the Flathead crania are effected during infancy, involving as it does, great relative displacement of the cerebral mass, but little or no diminution of the internal capacity. The discovery of numerous traces of domestic pottery, pipes, stone implements and weapons in the same locality, furnishes abundant proof that it was the site of the Indian village as well as a cemetery, and thereby demonstrates the probability of the erection of such a structure, or the accumulation of some ponderous mass over the grave at a period so near to that of the original interment, as would abundantly suffice to produce the change of form described. To some such causes similar examples of posthumous cranial malformation must be ascribed; as they are so entirely exceptional as to preclude the idea of their resulting from the mere pressure of the ordinary superincumbent mass of earth.

"Another skull found in the same ancient Indian cemetery, apparently that of a female, and now in the collection of Mr. Guilbault, of Montreal, has also the appearance of having been modified in form by artificial means, whether posthumous or otherwise. The supercilliary ridges are prominent, the frontal bone is receding, but convex, and the occipital bone has considerable posterior projection, which is rendered the more prominent by a general flattening of the coronal region, and a very marked depression immediately over the lambdoidal suture, pro-

bably the result of unequal posthumous compression. The abnormal conformation of this skull is shown in the proportions of the intermastoid arch, which measures only 11.75, while the normal mean, so far as ascertained by me from measurements of thirty-three examples of Algonquin crania is 14.34, and of thirty-six examples of Huron crania is 14.70."

The teeth of most of the skulls found are remarkable for their regularity, though in old age they were much worn, and many were lost by decay. In two examples however, both of persons who must have died in youth, the teeth were very unequally developed. All the entire skeletons repose in a crouching posture, not erect, but inclined or lying on one side, and usually with the head towards the west. In a few instances, skulls and portions of skeletons were found detached; but these seem to have been disturbed by the plough or by modern excavations. Two very remarkable exceptions to the general mode of occurrence of the human remains deserve special notice.

Near one of the cooking places, and at the depth of about 2 feet, intermixed with the bones of wild animals and fragments of pottery and charcoal, were found portions of a human jaw, which had belonged to an immature individual, and had evidently been broken, or gnawed by animals, when recent. This might raise a suspicion of occasional cannibalism on the part of the inhabitants of Hochelaga, were it not for the possibility that it may be a memorial of the destruction of the village, in which it is probable that many of its people both young and old, may have perished in the ruins of their dwellings. It can scarcely be connected with the tortures or indignities inflicted on prisoners of war, as these remains were not those of an adult; but it may possibly refer to the practice indicated by the specimens next to be described.

These are two vessels, possibly drinking cups, formed of portions of human skulls. One of them was given to me by Mr. Dand, the other is in the collection of Mr. Murphy. Both have been formed of parietal bones, rudely cut and smoothed around the edges, and one has a round hole in the margin for a handle or string. These relics, no doubt, point to the custom, attributed to several of the primitive tribes of the old world, of using the skulls of slain enemies as vessels for domestic uses. Whether this practice is to be ascribed to the inhabitants of old Hochelaga, or to the enemies by whom it was destroyed, is less certain, and

it may be well perhaps to give the hospitable entertainers of Cartier the benefit of the doubt.

2. *Beads or Wampum.*—Only a single specimen of the shell wampum, or "Esurguy" as Cartier calls it, has been found. It is represented in Fig. 1, and is of small size, neatly formed, and the material is apparently the pearly shell of a Unio, probably *U. ventricosus.** Such beads, from their small size and the labour required in their manufacture, must have been very valuable, while their pearly lustre would render them more beautiful than the wampum of the coast Indians. If this single specimen really represents the beads to which Cartier alludes, it accords with his statement that the material was obtained in the river, but does not explain his curious account of the mode in which it was procured.

Fig. 1.

Fig. 2.

Many examples have been found by Mr. Murphy and myself, of discs of baked clay, rudely ornamented and perforated through the centre, as in Fig. 2. These seem to have been a cheaper and commoner kind of beads.

3. *Bone Implements.*—These are very numerous and of various forms. Fig. 3 represents the point of a barbed fish spear; Fig. 4 may have been a spear point or arrow head, and Fig. 5 represents a bone needle. A great number of pointed implements, perhaps daggers, spear heads or skewers, have been found, some of them very neatly formed, but without any attempt at ornamental carving. Bone stamps for impressing patterns on pottery are not uncommon, and numerous examples have been found of objects of unknown use formed of bones of the feet of quadrupeds, ground flat on one side and hollowed in a peculiar manner, with a small hole bored in one end. Bone seems to have been largely used by these people for implements of various kinds, and the

* Or *U. Canadensis* of Lea, which is perhaps only a variety of the species named in the text.

neatness with which these have been shaped and polished, is very creditable, in the case of workmen not provided with metallic tools.

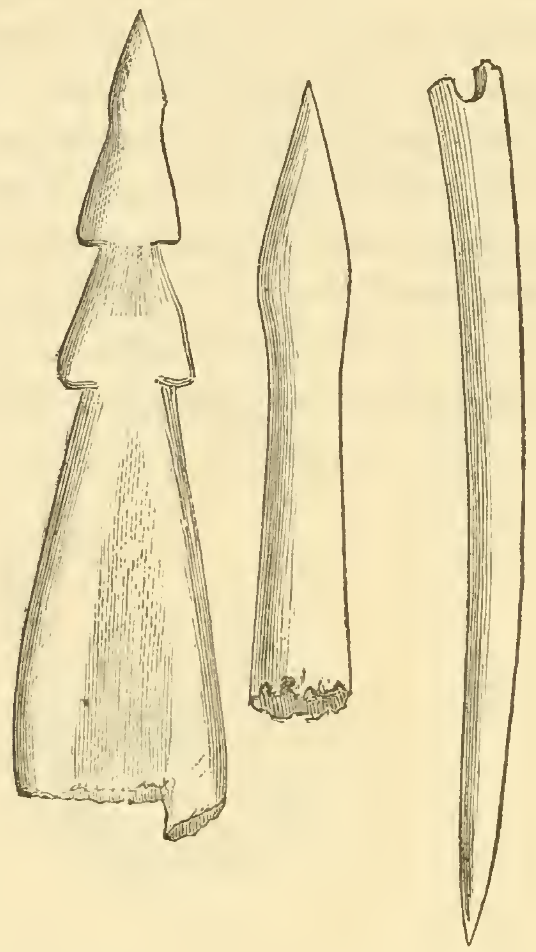

Fig. 3. Fig. 4. Fig. 5.

4. *Pipes.*—The taste and skill of the Indian potters have been expended on these more than any other objects of their art.

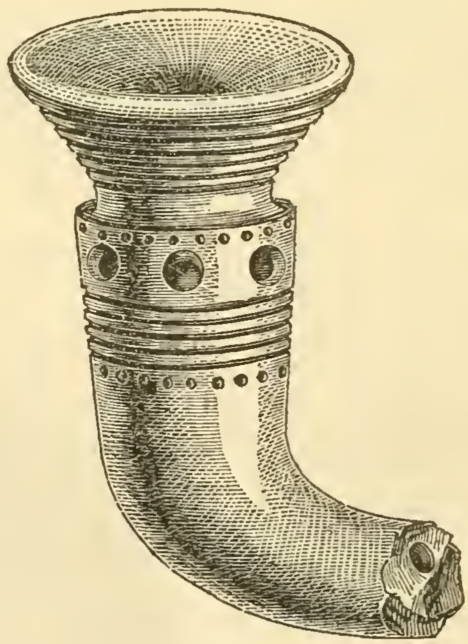

Fig. 6.

Many of them are formed in the elegant and simple pattern figured in my former paper. Others have very regular revolv-

ing bands or rings, relieved by round impressions, (Fig. 6.) One has a square stem ornamented with delicate transverse lines. Another has a rude attempt at a human countenance on the front of the bowl. The most elaborate, though perhaps not the most tasteful of the whole, is in the collection of Mr. Murphy, and is represented in Fig. 7, which is a side view of half the actual size. The front, which is not represented in the figure, is broad and flat, and has a rude human face, surrounded by a sort of halo composed of rectangular indentations arranged in consecutive rows. The only example of a stone pipe is a small fragment of a stem formed of serpentine, similar to that of the "Calumets" on the Ottawa.

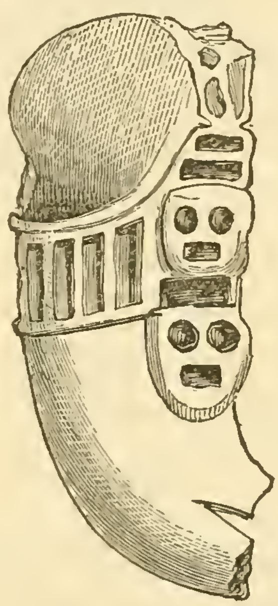

Fig. 7.

5. *Earthen Vessels.*—Large quantities of fragments of these have been collected; all in styles similar to those figured in the former paper, and which may be characterised as the *basket* patterns,* and *corn-ear* patterns,† though presenting great varieties in detail. In some of the more elaborate the ornamental lines are not mere scratches, but consist of series of impressions made by a pointed instrument, giving a very rich effect. In some of the examples more recently found, the sides are unusually thin and the material very fine, while others appear to have been large, thick, and composed of coarse and slightly baked material. In many of the vessels the mouth is square with the corners thickened and expanded, perhaps for convenience of hand-

* Fig. 7. Canadian Naturalist, vol. 5, p. 435.

† Fig. 10. Canadian Naturalist, vol. 5, p. 435.

ling or of suspension over the fire. In one example found by Mr. Murphy, (Fig. 8,) this corner is fashioned into a human head, which though rude in execution displays some artistic taste in its design. The vessel to which it belonged must have been used for culinary purposes, for like many others in the collection, it is crusted with the carbonised remains of some vegetable pottage.

Fig. 8.

6. *Stone Implements.*—These consist of chisels of the ordinary form, made of greenstone and gneiss; hammers, some with grooves for attachment to handles, and others rounded for use with the naked hand, after the fashion of those represented on Egyptian monuments; flat stones for baking or for preparing skins, and whet-stones with grooves made by sharpening implements upon them. There are also great quantities of stones which have been heated in the fire, probably for baking cakes of corn meal in the Indian manner.

7. *Metallic Articles.*—Of the few objects of this kind which have been found in such circumstances as to render accidental intermixture improbable, the most interesting are a small knife resembling a scalpel; a nail deprived of its head, and rounded and sharpened at the point; and a small rectangular piece of sheet brass, apparently cut by a stone chisel or some similar implement from a larger piece. These are sufficient to shew European intercourse before the final disappearance of the Indian settlement.

8. *Articles of Food.*—The bill of fare of old Hochelaga appears to have included nearly all the wild mammals of the country, and many birds and fishes; but the beaver largely predominates, and remains of the bear, more especially lower jaws, are quite numerous. Grains of Indian corn were mentioned in my former paper, and in one spot rich in the debris of pottery, and recently excavated, these are very abundant, and apparently of the ordinary variety still cultivated in the country. In the same place I found a single bean, apparently the *Phaseolus vulgaris*, bearing witness to the cultivation of this plant as well as corn. The grains of corn and beans which have been preserved, are those which have been accidentally charred in the cooking fires. They are perfectly black and very friable. In one spot was found a large quantity of charred acorns, which may have been used as food in times of scarcity. The stones of the wild plum are very common, and Mr. Murphy has found specimens of butternuts.

Suites of specimens of the objects referred to in this paper, will be deposited in the collections of the Natural History Society, and of McGill College, to secure the preservation of these slender memorials of the rude arts and simple lives of our predecessors in the occupancy of the Island of Montreal—so unfortunate in the early extinction of their name and race, but happily preserved from oblivion in the record of their hospitality and kindness to the old French voyager, and by the confirmations of his veracity which have now so unexpectedly occurred.

In the Report of the Smithsonian Institution for 1856, there is a notice by Mr. Guest of the remains of Indian villages near Prescott, C. W.; and it is very interesting to observe the similarity in details between the relics found there and those obtained at Montreal. The dimensions of the trees which are stated to have grown on the sites of these forts or villages at Prescott, would indicate a date for their abandonment earlier than the discovery of Canada. They appear to deserve further investigation, more especially with a view to the question whether they belonged to the Hurons or to a preceding population akin to that of Hochelaga.

J. W. D.

ARTICLE XXVIII.—*Mr. Barrande on the Primordial Zone in North America, and on the Taconic System of Emmons.* By T. Sterry Hunt, M.A., F.R.S.

We are indebted to the courtesy of the author for a copy of his paper on this subject, extracted from the 18th volume of the Bulletin of the Geological Society of France, and including three communications made to that Society, November 5 and November 19, 1860, and February 4, 1861. The communications of Sir W. E. Logan, and of Mr. Billings, which have appeared in the *Naturalist*, have already made our readers acquainted with the most important facts bearing on the question before us, and we may also refer to our paper on American Geology in the April number, written before the reception of Mr. Barrande's memoir. This the author has divided into eight chapters, in the first four of which he discusses the evidences of a primordial fauna in Canada, Vermont, Tennessee, Texas and Nebraska. Our readers are already aware that in 1859, Mr. Hall described three species of *Olenus* from Georgia, Vermont, besides which the observations of Roemer, Shumard, and Safford, have shown the existence of related genera, in Tennessee, Nebraska and Texas, where they occur in strata which are recognized by these authors as being at the base of the palæozoic series. The observations of Mr. Barrande upon the remarkable fauna from Point Levis, are so important that we translate them at length, referring to Mr. Billings's description of the four groups of fossils, which will be found in the *Naturalist* for August 1860, Vol. V., p. 301.

"The group No. 1 is distinguished from all the others by several very remarkable characteristics. Of the eight genera of fossils, two are brachiopods and six trilobites, so that the latter furnish three-fourths of the types of the group. If we compare the species, the brachiopods are three and the trilobites eighteen in number, or six-sevenths of the known species of the group. These numerical relations, indicating a great predominance of trilobites, recall in a striking manner one of the principal characters of the primordial fauna.

"Among the trilobitic types are four forms which up to the present time, have been found to belong exclusively to the primordial fauna; namely, *Concephalites*, *Arionellus*, *Menocephalus* and *Dikellocephalus;* besides which the genus *Agnostus* furnishes

three distinct species, in place of the single one which is found in the group No. 2.

"The two genera, *Lingula* and *Discina*, which complete the fauna of the first group, are among those which are found in the primordial fauna almost everywhere that it has been observed; but here, as elsewhere, the number of species of these genera is very limited.

"With these facts before us, it would be impossible, from a palæontological point of view, not to recognize the primordial fauna in the group No. 1. It will be understood that if for the time being, we neglect all other considerations, it is because stratigraphy has not as yet furnished any facts which can be appealed to for the solution of the question.

"We will now compare the fossils of the 2nd group. They consist of seventeen genera, of which only three are trilobites; of these two, *Agnostus* and *Bathyurus*, occur in the first group, while *Cheirurus* is here met with for the first time, so that the crustaceans have no longer the great predominance which is apparent in the preceding group. Besides *Cheirurus* is a type which has never yet been observed in any country earlier than the second fauna, and the same is true of the genus *Amphion*, of which Mr. Billings thinks he has discovered a pygidium which is figured in his memoir, although the genus is not mentioned in the list which he has given. On the other hand, we know that *Agnostus*, although it ascends to the summit of the second fauna, never goes above it, so that the crustaceans of the second group taken together, represent the second fauna.

"The cephalopods are here represented by the two genera, *Orthoceras* and *Cyrtoceras*, furnishing together nine species, and we may remark that the species of the latter genus, four in number, are relatively numerous for such a horizon. Now the cephalopods, which are not rare in the second fauna, have never been observed in the primordial fauna. In the table which we published in 1859 (*Bull. of the Geol. Society of June*, XVI. 543), we have it is true indicated, with a doubt, the presence of an *Orthoceras* in the primordial fauna of Scandinavia. We however take advantage of the present occasion to correct this indication, which as we have mentioned in our *Parallele* p. 43, was furnished by Mr. Angelin. This savant, who is now with us, informs us that he has lately established in the most positive manner, that the orthoceratite in question really occurs in his region *B C*=*Cerato-*

pygarum, that is to say in the alum slates with limestone beds, which contain the first portions of the second fauna in Sweden. In accordance with this fact, it would appear that the cephalopods indicated by Mr. Billings in his 2nd group must be referred to the second fauna.

"The gasteropods furnish to the second group six genera, which are commonly found in the second fauna of various countries, but as these types are reproduced in the third fauna, their presence here has no bearing upon the question before us.

"The acephala are only represented by the new genus *Cyrtodonta* lately established by Mr. Billings, according to whom the eleven species of this genus already described, belong to the Black River and Trenton limestones, i. e., to the second fauna of Canada, although allied forms may also occur in the third fauna. (*Canadian Naturalist*, December 1858, p. 331.)

"The class of brachiopods, which is relatively but little developed, offers four genera, *Lingula*, *Orthis*, *Strophomena* and *Camarella*, which last genus was founded by Mr. Billings in 1859, to include several species of the second fauna of Canada, (*Canadian Naturalist*, August, 1859, p. 301). Nothing however indicates that similar forms may not also occur in the third fauna, as is the case with the three other genera mentioned. Thus the fossils of this class, generically considered, establish nothing as to the geological horizon of the second group, although it is very probable that the study of their specific forms may aid us in finding its horizon.

"The bryozoa furnish to the second group a form of *Dictyonema*; a type which although signalized in the Primordial Zone of different countries, does not appear to be confined to that horizon. The specific nature of the form in question has not yet been determined.

"In conclusion we may say that the association of *Agnostus* with the various other genera which we have just passed in review, seems to shew in a positive manner that the second group belongs to the second fauna. This conclusion may be extended with still greater reason to the group No. 3, which contains only the genus *Asaphus*, represented by two species. This type has never been signalized either above or below the second fauna, of which it constitutes one of the most marked and most constant characters. The second and third groups considered palæontologically, then represent simply phases of the second fauna.

"The 4th group only containing two types, *Orthis* and *Tetradium*; the latter, a polyp, presents no certain sign enabling us to give the epoch to which it belongs. The palæon tological data furnished by Mr. Billings, considered apart from the stratigraphical relations yet to be determined between the four groups, lead us to recognize the existence both of the primordial and the second fauna in the calcareous rocks of Point Levis. It is important to remark that these faunas, although occurring in beds very near each other, have as yet offered but few evidences of connection, since Mr. Billings has only indicated two species common to the groups 1 and 2.

"Such are the only deductions which we believe ourselves entitled to draw from the interesting facts above mentioned. We do not wish to pass the limits of the most prudent reserve in the case, because the facts briefly expressed by Mr. Billings in the introduction of his descriptions of the Point Levis fossils, indicate that there are some difficulties yet to be resolved. We observe in the first place, that all these limestones, without distinction, are indicated as being intercalated in a great schistose formation, which has furnished about thirty forms of graptolites, and other analogous fossils, with two Lingulas, one Orthis, one Discina, and one small unknown trilobite. It would be very important to establish whether the species belonging to these schists are found indifferently at various heights, above, below and between the limestones. Without very precise observations to determine and limit the distribution and the extension of these fossils in the schists, it would be impossible to form an exact idea of the relations which may exist between the representatives of the first and second faunas contained in these limestones.

"In the second place, the introduction of Mr. Billings concludes by the following passage which merits special attention. 'It is not yet certain whether the fossils of the limestones are included in the boulders or the paste of the conglomerate.' There exist then in the limestones in question, two rocks of different origins, the one represented by boulders, which we may suppose to have been transported from a distance, and the other formed upon the spot by ordinary sedimentation. While waiting for light upon these points, we will add the following considerations:

"I. It is established by Mr. Billings that the four groups of fossils are each enclosed in a rock distinct in appearance, and that these rocks form different beds, between which there are yet but

very few species in common. With these facts, even if it should one day be proved that the fossils belong to the broken and transported fragments of rock which enter into the conglomerate, it will not be less true that the primordial and secondary faunas must have belonged to separate formations in the region which furnished the transported materials, for it is evident that if these fossil species had been originally mingled in a common formation, no physical cause could have assorted and separated them, so as to form the two distinct groups which represent the primordial and secondary faunas in the rocks at Point Levis.

"II. We must also remark that if any admixture of the species of the two faunas should ultimately be found in these conglomerates near Quebec, it would in no wise prove that there had been a similar commingling in the locality which had furnished the boulders of these conglomerates, for the fact of their having been transported, would of itself suffice to explain such an apparent co-existence or confusion of the two faunas."

In the fifth chapter Mr. Barrande discusses the Taconic system of Dr. Emmons. This geologist, while engaged in the survey of a part of the State of New York, recognized the existence of a series of sedimentary rocks, which he regarded as older than those supposed by his colleagues to represent the Silurian series. A similar view had been maintained by Eaton, but was rejected by most of the American geologists, who up to this time have regarded these Taconic rocks of Emmons as belonging to the Lower Silurian series. In 1844 Dr. Emmons described certain fossils from these rocks, which he supposed to be new and to distinguish what he called the Taconic system, regarded by him as the true palæozoic base. In 1846 Mr. Barrande discovered in Bohemia, beneath the horizon of the hitherto recognized Silurian fossils, a new and extensive fauna in what he designated the Primordial Zone. The fossils described by Dr. Emmons consisted, besides some imperfect trilobites, of a few graptolites, mistaken by him for fucoids, and several very doubtful forms which are valueless for the purpose of determination. According to Dr. Emmons this system, which he divides into an upper and lower portion, has a thickness of 30,000 feet, and extends throughout the whole Appalachian chain. He has described it as composed in ascending order of, 1st. Granular quartz; 2nd. The Stockbridge limestone; 3rd. Magnesian slates ; 4. Sparry limestone ; 5. Roofing slates (graptolitic) ; 6th. Silicious conglomerate ; 7th. Taconic slates ; 8. Black slates.

This is not their apparent order of superposition, but Dr. Emmons conceives that the whole series has been inverted since its deposition. In fact the schistose strata 5, 6, 7 and 8, pass successively beneath the magnesian slates and limestones, which in their turn are overlaid to the east by the Green Mountain gneiss. This latter formation Dr. Emmons regards as a primitive azoic rock, upon which were successively deposited the members of the Taconic system, commencing with the quartzite, which forms its base, and crowned by the black and Taconic slates, which are now, from an immense overturn, placed at the bottom of the series, while the ancient gneiss lies at the top. It is hardly necessary to say that this supposition is wholly unwarranted by the facts. In the paper on American geology already cited, we have shown that the apparent succession of the rocks of the Quebec group is the true one. The black slates are really at its base and successively overlaid by the conglomerates, roofing slates, limestones and quartzites, and the gneiss is a newer rock, being no other than the Sillery sandstone in an altered condition, and as we have there shewn, entirely distinct from the Laurentian gneiss. Dr. Emmons has fallen into an error, similar to that of Prof. Nichol with regard to the gneiss of the Scottish Highlands, so well refuted by Murchison, Ramsay and Harkness, and has consequently been driven, in order to explain the structure of the Green Mts. to admit not merely an upthrow with Nichol, but a complete overturn of the whole palæozoic series in question. As to the geological age of this series, Dr. Emmons maintains that his Taconic system occupies a position inferior to the Champlain division of the New York system, and is consequently beneath the Lower Silurian system of Murchison. As we have before shown however, the fossils of the Quebec group prove it to be the palæontological equivalent of the Calciferous sandrock. The Stockbridge and sparry limestones, with their accompanying slates (excepting only 7 and 8,) we conceive to be no other than the Quebec group, of which they have both the stratigraphical position and the lithological characters. Dr. Emmons has maintained that limestones of the age of the Calciferous are found overlying the black slates, and has appealed to this in proof of the antiquity of the whole series, of which he imagined these slates to form the summit, but inasmuch as these slates are really older than the Quebec or Calciferous strata, his argument falls to the ground. Mr. Billings has lately found *Conocephalites* in the red sandrock of Highgate,

Vermont, which is supposed to overlie the black slates in question. As this primordial genus occurs also in the Potsdam sandstone of Lake Champlain, the question arises whether these slates are palæontologically distinct from the Potsdam, or are only its deep sea equivalent, sustaining to the littoral formation of quartzose sandstone on Lake Champlain, the same relation as the great Quebec group does to the Calciferous sandrock of the New York geologists. Dr. Emmons claims that the whole of his Taconic system is inferior to the Potsdam sandstone, which is the admitted base of the Champlain division, but we have already shown that the whole of his system, with the probable exception of these slates, is of the age of the Calciferous sandrock, the second member of that division. Unless then these lower black slates contain a fauna distinct from and older than that of the Potsdam sandstone, there remains absolutely nothing of the Taconic system which Dr. Emmons placed below the base of the Champlain division, that is to say, below the Potsdam sandstone. If, however, as is probable, these slates contain a fauna distinct from the Potsdam, they might be retained under the name of the Taconic formation, as a lower member of the Primordial Zone, to which the Potsdam sandstone unquestionably belongs.

These lower slates in Georgia, Vermont, have as already remarked furnished certain trilobites of primordial type which Mr. James Hall has described under the name of *Olenus Vermontana* and *Olenus Thompsoni*, though they are provisionally referred by Barrande to the genus *Paradoxides*. In the meantime the only trilobite as yet met with in the typical Potsdam sandstone of this region, which is rarely fossiliferous, is *Conocephalites*.* A collection of fossils recently made by Mr. James Richardson in exploring the Straits of Bellisle for the Geological Survey of Canada, fortunately furnishes the means of determining the relations of the trilobites described by Mr. Hall. On the north side of the Straits he found reposing on the Laurentian rocks a coarse reddish sandstone holding *Scolithus* like that from the Primal sandstone of Pennsylvania. Resting upon this, and dipping gently southward, is a limestone in which occur both *Olenus*

* Mr. Barrande refers to three species of *Dikellocephalus* indicated by Dr. Bigsby as occurring in the Potsdam of New York. It will be seen by referring to his memoir (Quar. Jour. Geol. Soc. 1858, p. 339, compared with p. 420,) that Dr. B. alludes only to the existence of these species as described by Owen in the Mississippi valley.

Thompsoni and *O. Vermontana*, with what appears to be an *Arionellus*, besides *Obolus*, *Capulus*, and a large spirally marked coral resembling *Zaphrentis*. These rocks, which evidently represent the Primordial Zone, are overlaid by others containing the characteristic fossils of the Calciferous sandrock and the compound graptolites of the Quebec group. These primordial trilobites then overlie the sandstone with *Scolithus*, but as we have elsewhere observed, that species appears unlike the *Scolithus* from the Potsdam of Lake Champlain, and should not be too much relied upon for fixing the geological age of this formation. It is not improbable that the true equivalent of the Conocephalites and Lingula sandstones of Lake Champlain will be found in some of the strata above the Olenus beds of Bellisle.

We have seen that Emmons, guided by a false notion of the age of the Green Mountain gneiss which led him to admit an inversion of the whole series, placed the shales which form a portion of the Primordial Zone high in the second fauna, above the whole Quebec group. On entirely different ground, Hall assigned the shale containing *Olenus*--two species of which genus he described in 1847 in the 1st Vol. of the Palæontology of New York,—to the Hudson group. In this, as Barrande shows, Mr. Hall felt himself justified by the authority of Hisinger, who in his great work on the fossils of Sweden, *Lethœa Suecica*, 1837, gives the succession of palæozoic rocks in Sweden as follows in ascending order; 1. Fucoidal sandstone; 2. Orthoceratite limestone; 3. Alum slates with *Olenus*; 4. Argillaceous slates with graptolites, etc.

The *Olenus* slates, said by Hisinger to overlie the orthoceratite limestone, (corresponding to the Trenton,) Mr. Hall unhesitatingly regarded as the equivalents of the Hudson group, in which *Olenus* was to be looked for as a characteristic fossil, and hence the strata containing these trilobites were, on the authority of Hisinger, regarded as belonging to the summit of the second fauna. In reality however this order assigned by Hisinger to the formations of Sweden is false, since the alum slate with *Olenus* lies below, and the graptolitic slate above the orthoceratite limestone. This error of Hisinger is the more strange since he had long before, as Barrande shows, indicated the true succession of these rocks, and is perhaps a mistake of the copyist or printer; it is the more to be regretted as his authority had caused it to be adopted by Mr. Hall in America. (*Geol. of Lake Superior*, *Foster and Whitney*, II. pp. 298—318.) The alum slate with the underlying sandstone represents in Sweden the primordial zone.

To Dr. Emmons undoubtedly belongs the merit of having recognized for the first time the trilobites which are known to belong the primordial zone, although from incorrect notions of stratigraphy he placed the slates containing them at the summit of the series of rocks to which he gave the name of the Taconic system. We have shown that the true place of these shales is at the base of the series, and that the remainder of the Taconic system is the palæontological equivalent of the Calciferous sandrock; it is not yet certain whether these lower shales with a primordial fauna do not sustain a similar relation to the Potsdam sandstone, in which case the whole of the Taconic system would be the equivalent of the two lower groups of the Champlain division. It yet remains to be seen whether Dr. Emmons can retain from the wreck of his system, the lower slates as a Taconic formation older than the Potsdam sandstone of Lake Champlain, and subordinate to the Primordial Zone, whose fossils he was the first to recognize.

Mr. Barrande refers to the opinion expressed by Mr. Marcou that the rocks beneath the fall at Montmorenci, near Quebec, are Primordial, and are overlaid unconformably by the Trenton limestone found above the fall, contrary to the statement of Sir William Logan in his report for 1852-53, that these rocks are the upper members of the Lower Silurian series, brought down by a fault. A reference to Sir William's paper in this Journal for June last, will show that the strata at the base of the fall, so far from being Primordial, contain in abundance the fossils of the Trenton and Utica formations, and that the latter may be traced over to the north side of Orleans Island, beyond which is the overlap that brings to the surface the rocks of the Quebec or Calciferous group.

Mr. Barrande then observes that " the results from the study of the Quebec group are another proof of the prompt and efficient aid which palæontology lends to geology, when local circumstances put at fault all the resources of stratigraphy." He next proceeds to analyze Sir William Logan's letter of December last, (this Journal Jan., 1861) and expresses his entire accordance with the views therein advanced, concluding with the following tribute to the labors of the Geological Survey, which we may be pardoned for reproducing.

" The vast regions of Canada have only within a few years been made known to geologists, and that they have already greatly attracted the attention of savants, is due solely to the rapid and productive labours of the Geological Commission which

is charged with the survey of the country. Let us remember that one of the most honourable distinctions that France has ever accorded to geology was in 1855, conferred on this commission, that is to say, on Sir W. E. Logan who directs it, and his learned colleagues. All of us, simple laborers or volunteers in the science, then applauded these international honours, for we well knew how to appreciate the difficulties and the merits of explorations made on so vast a scale. It is therefore with gladness that we seize the opportunity now again offered us, to express to our Canadian *confrères* all our personal sympathies, and our best wishes for the successful completion of the arduous and honourable task which has been committed to them."

ARTICLE XXIX.—*List of Coleopterous Insects.* Collected in the County of Lincoln, C. W., by D. W. BEADLE, of St. Catherine's, C. W.

[The specimens were submitted to Dr. John L. Le Conte of Philadelphia, and to him the collector is indebted for their names.]

CICINDELIDÆ.

Cicindela purpurea. Say.
C. sexguttata. Fabr.
C. duodecimguttata. Dej.
C. vulgaris. Say.
C. punctulata. Fabr.

CARABIDÆ.

Galerita bicolor. Drury.
Lebia atriventris. Say.
Brachinus ———?
Calosoma calidum. Fabr.
Omophron Americanum. Dej.
Elaphrus ruscarius. Say.
Chlænius sericeus. Forst.
C. Pennsylvanicus. Say.
Dicælus elongatus. Say.
Agonum punctatum. Fabr.
A. cupripenne. Say.
A. excavatum. Dej.
Poecilus lucublandus. Say.
Amara impuncticollis. Say.
Agonoderus lineola. Fabr.
Harpalus erraticus. Say.
Stenolophus conjunctus. Say

Bembidium inequale. Say.
B. patruele. Dej.
B. 4 maculatum. Lec.
Tachys inornatus. Say.

DYTISCIDÆ.

Dytiscus Harrisii. Kirb.
Acilius fraternus. Harris.
Agabus ——— ?

HYDROPHILIDÆ.

Helophorus lineatus. Say.
Hydrocharis obtusatus. Say.
Hydrobius regularis. Lec.
Cercyon ——— ?

SCAPHIDIIDÆ.

Scaphidium ——— ?

SILPHIDÆ.

Necrophorus orbicollis. Say.
Necrodes surinamensis. Fabr.
Thanatophilus caudatus. Say.
Silpha inequalis. Fabr.

NITIDULIDÆ.

Ips fasciatus. Oliv.
I. 4 signatus. Say.
Trogosita castanea. Mels.

CUCUJIDÆ.

Cucujus clavipes. Oliv.
Brontes dubius. Fabr.

EROTYLIDÆ.

Dacne fasciata. Fabr.
D. heros. Say.
Triplax thoracica. Say.
Languria Mozardi. Latr.

MYCETOPHAGIDÆ.

Mycetophagus flexuosus. Say.

DERMESTIDÆ.

Dermestes lardarius. Linn.
D. nubilus. Say.

THROSCIDÆ.

Lissomus geminatus. Say.

HISTERIDÆ.

Hister interruptus. Beauv.
Platysoma depressum. Lec.

LAMELLICORNIA.

Copris ammon. Fabr.
Onthophagus Hecate. Panz.

Aphodius fimetarius. Fabr.
A. inquinatus. Fabr.
A. granarius. Linn.
Trox æqualis. Say.
Geotrupes Blackburnii. Fabr.
Lucanus dama. Thunb.
Dorcus parallelus. Say.
Platycerus quercus. Web.
Passalus cornutus. Fabr.
Pelidnota punctata. Linn.
Cotalpa (Areoda) lanigera. Linn.
Phyllophaga quercina. Knoch.
Serica (Omaloplia) sericea. Illig.
Dichelonycha subvittata. Lec.
Hoplia trifasciata. Say.
Osmoderma scabra. Beauv.
Trichius affinis. Gory and Perch.
Erirhipis (Cetonia) inda. Linn.
E. fulgida. Fabr.

BUPRESTIDÆ.

Chrysobethris femorata. Fabr.
C. dentipes. Germar.
Agrilus ruficollis. Fabr.
A. fallax. Say.
Brachys tessellata. Fabr.

ELATERIDÆ.

Cratonychus communis. Schönh.
Adelocera marmorata. Fabr.
A. aurorata. Say.
A. pennata. Fabr.
Alaus oculatus. Linn.
Elater linteus. Say.
Cryptohypnus silaceipes, Germ. Zeitschr.
Corymbites hieroglyphicus. Lec.
C. acutipennis. Lec.
Agriotes mancus. Say.

LAMPYRIDÆ.

Ellychnia corrusca. Linn.
Chauliognathus Pennsylvanicus. Geer.
Telephorus Carolina.
Podabrus modestus. Say.

CLERIDÆ.

Trichodes humeralis. Lec.
Thaneroclerus sanguineus. Say.

CURCULIONIDÆ.

Cryptorhynchus (Conotrachelus) nenuphar. Hbst.

Centrinus scutellumalbum. Say.
Magdalinus ——— ?
Lixus ——— ?
Hylobius pales. Hbst.
Arrhenhodes maxillossus. Oliv.
Arrhenodes (septentrionis.) Herbst.
Cratoparis lunatus. Fabr.
Bruchus pisi.

CERAMBYCIDÆ.

Parandra brunnea. Fabr.
Orthosoma cylindricum. Fabr
Prionus brevicornis. Fabr.
Asemum moestum. Hald.
Arhopalus fulminans. Fabr.
Physocnemum brevilineum. Say.
Clytus colonus
C. flexuosus. Fabr.
C. erythrocephalus. Oliv.
Euderces picipes. Fabr.
Graphisurus fasciatus. Geer.
Monohammus confusor. Kirb.
Tetraopes tetrophthalmus. Forst.
Saperda tridentata. Oliv.
S. vestita. Say.
Oberea ——— ?
Rhagium lineatum. Oliv.
Leptura (Strangalia) fugax. Fabr.
Leptura vittata. Oliv.
L. sphæricollis. Say.

CHRYSOMELIDÆ.

Lema trilineata. Oliv.
Hispa (Anoplitis) quadrata. Fabr.
Cassida pallida. Herbst.
Diabrotica trivittata. Mann.
Phyllobrotica discoidea. Fabr.
Disonycha Pennsylvanica. Illiger.
D. ——— ?
Systena frontalis. Fabr.
Crepidodera violacea. Mels.
Labidomera trimaculata. Fabr.
Chrysomela scalaris. Lec.
C. Bigsbyana. Kirby.
C. elegans.
C. polygoni.
Paria (Colaspis) 6 notata. var. Say.

COCCINELLIDÆ.

Hippodamia 13 punctata. Linn.
Coccinella bipunctata. Linn.
C. novemnotata. Herbst.
C. munda. Say.
Mysia 15 punctata. Oliv.
Chilocorus bivulnerus. Mulsant.

ENDOMYCHIDÆ.

Endomychus biguttatus. Say.

TENEBRIONIDÆ.

Platyderna ruficornis. Sturm.
Diaperis hydni. Fabr.
Hypophloeus parallelus. Mels.
Tenebris castaneus. Knoch.
T. tenebrioides. Beauv.
Bolitophagus cornutus. Panzer.
Meracantha Canadensis. Kirby.
Helops micans. Fabr.
Penthe obliquata. Fabr.
P. pimelia. Fabr.

MELANDRYIDÆ.

Pytho Americanus. Kirby.

MORDELLIDÆ.

Mordella melaena. Germ.
M. ——— ?

MELOIDÆ.

Lytta (Epicauta) vittata. Fabr.
L. ferruginea. Say.
Asclera ruficollis. Say.

LAGRIDÆ.

Statyra cenea. Say.

PYROCHROIDÆ.

Pyrochroa flabellata. Fabr.
Dendroides Canadensis. Latr.
Schisotus cervicalis. Newm.

ANTHICIDÆ.

Anthicus formicarius. Ferté.

STAPHYLINIDÆ.

Staphylinus villosus. Gravenhorst.
S. vulpinus. Erichson.
S. cinnamopterus. Gravenh.
S. violaceus. Gravenh.
Philonthus apicalis. Say.

REVIEWS AND NOTICES OF BOOKS.

Memoirs of George Wilson, M.D., F.R.S.A., Regius Professor of Technology in the University of Edinburgh, &c. By his Sister, Jesse Aitken Wilson. Edinburgh, Edmonston & Douglas: Montreal, B. Dawson & Son.

This memoir has been undertaken by its accomplished authoress at the urgent solicitation of attached friends of George Wilson. Although written by his sister, as a true work of affection, there is yet no such partiality manifested in its pages as the character of the beloved brother will not justify in the estimation even of strangers. An honest and earnest attempt has been successfully made throughout truthfully to delineate the character of the man, the Christian, and the philosopher. From the mass of letters which the warmth and generosity of Dr. Wilson's friendship led him to write to his intimate associates, the life, in a great measure, partakes of the character of an autobiography. Nor are these letters mere common-place pieces of correspondence; they possess all the beauty of the letters of Walpole and the Christian simplicity of those of Cowper; they have besides a feature which the familiar productions of neither of these eminent men possess, in any appreciable degree,—they are radiant with the sunshine of a large and happy heart; they have, in short, a fine commingling of literature, science, poetry, and joyous affection.

There was nothing of what may be styled an eventful kind in the life of this esteemed minister of science. He took no part in any movements of historical importance; he inaugurated no new era of science; and while his original investigations were both important and numerous he still cannot be said to have been a great discoverer. What was it then that gave such a charm to the productions of his pen and to his public and private expositions of science? It seems to have been the rare combination of poetic genius and careful observation of physical phenomena and their mutual relations, together with a wakeful and Christian philanthropy. All his writings thus sparkle with original observations, teem with beautiful and fit analogies, and present fact and truth

in their relations to human welfare. He died at a time when his mental powers had attained a ripeness, and his scientific knowledge a fulness, that gave promise of bold incursions into the secret treasures of nature. We can conceive of him, as standing on the boundless shores of truth, and prepared, from the utmost limits of discovery, to penetrate with unwearied ardour into the yet unknown, that he might bring to light some new glories of the Divine wisdom by which the sum of human happiness might be increased. Those who love the beautiful in literature and science and who can appreciate manly Christian gentleness will find in this volume a rich repast.

We might quote many choice paragraphs from the pages of this memoir, but we confine ourselves to the following from the "Estimate by Dr. J. H. Gladstone" contained in the appendix, commending our readers to this delightful volume itself for a complete delineation of George Wilson's life and character.

AS A TECHNOLOGIST.

"Long before Dr. Wilson's appointment as Regius Director of the Industrial Museum of Scotland, he had, in his laboratory practice, been led to investigate several of the chemical arts. He had even published papers bearing more or less on some of them, as, for instance, that already referred to, which elucidated the theory of bleaching. But when his mind was specially turned to the subject of Technology, he put all his heart into it. It appealed at once to his intellectual and his moral nature: there was a vast range of inquiry, not too profound; and what was better still, that inquiry had a direct bearing on the happiness of his fellow-men. In the formation of the Industrial Museum he worked hard; and those who have enjoyed the advantage, as I have, of being conducted by him through the rich stores in readiness for the future building, can alone appreciate the care and thought which must have guided him in the selection and arrangement of such varied materials. Most wonderful and refreshing too was it to behold the enthusiasm with which he bore his feeble body over a manufactory, peeping into every process, collecting samples, and gathering the workmen around him, who always seemed delighted to tell him all they knew, or to listen to his kind and instructive remarks. His technological course, too, was largely attended, and in his inaugural lecture for 1855[1] he explained the nature of

[1] 'What is Technology?' Sutherland & Knox.

Technology as the science of the utilitarian arts, and expressed his intention of at once giving a systematic course, " so that the Museum will minister to the Chair, not the Chair wait upon the Museum."

AS A TEACHER AND EXPOUNDER.

" While many of Dr. Wilson's contemporaries could pursue a train of research with greater ability, none perhaps could render the new truth thus obtained so attractive by copious imagery and varied illustration. The expansiveness of his style, which led to his strictly scientific works being considered in some quarters too diffuse, is a beauty in those where he appears as the illustrator of our physical knowledge, for every figure tells, and every fresh point of view has its own peculiar value. His popularity as a lecturer, both with his students and with the public at large, was very great. This arose partly from his thorough knowledge of the subjects he handled, but more from the felicity of his descriptions, the clearness of his explanations, and the poetry and pathos which rendered the whole beautiful. His little book on chemistry in 'Chambers's Educational Course,' which is adapted for those who desire a knowledge of the fundamental principles and leading facts of the science, without entering into any great detail, has already attained a sale of upwards of twenty-four thousand, and that prose poem, the 'Five Gateways of Knowledge,'[1] has led many to find a new world of thought and enjoyment in the old region of their five senses. His treatise on Electricity and the Electric Telegraph[2] gives a most intelligible account of this wonderful agency; the 'Chemistry of the Stars' shows how he could carry the fancy of his readers forward from the results of dry analysis."

" As instances of the extraordinary clearness with which Dr. Wilson illustrated difficult points, I would refer to his exposition of the numerical laws of chemistry in the educational treatise just mentioned, which I think the most easily comprehensible in existence, and to his more popular description of the nervous system, given in Dr. Reid's Life."

" The beauty of Dr. Wilson's discourses and writings depended not a little on his religion, and on his fine æsthetic taste. His quotations from the Holy Scriptures, and references to spiritual

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[1] Macmillan & Co., Cambridge.

[2] These are printed together, and constitute Part 26 of the 'Travellers' Library.'

things, were frequent, not in the form of a pious deduction dragged in uncomfortably at the end of a lecture, but as the natural reflections of a mind thoroughly embued with the love of God and man, and accustomed to refer every good gift to the Father of Lights. In his addresses to medical or other students, he delighted to draw attention to the great facts of the spiritual world; but his 'Chemical Final Causes'[1] is the only one of his scientific writings which has a deliberately theological character. In it he attempts to add to the ever-accumulating proofs of design, by showing especially that phosphorus, nitrogen, and iron, are the best adapted of the known elements for the purposes they are required to fulfil in animal organisms."

"As to Dr. Wilson's æsthetic taste, he was an instance that a chemist is not one (to quote his own humorous description[2]) whose "vocation has been so prowl around, like a very demon, seeking what of the poet's property he might lay hands on and devour; to prove himself a man of the earth, earthy alike by profession and by relish for the work of a disenchanter, to whom a mystery is interesting only because it may be explained, and an object beautiful because the cause of its beauty may be discovered." The popular impression about some chemists, that "the aquafortis and the chlorine of the laboratories have as effectually bleached the poetry out of them, as they destroy the colours of tissues exposed to their action," certainly never arose from an acquaintance with Dr. Wilson. In his writings there is often a rhythmical charm and balance of expressions which suit well with the poetic quotations in which he sometimes freely indulges. As instances, I take almost at random from his discourse on the Progress of the Telegraph:—"We nicely discuss whether *telegram* is a proper word or not, and invoke the heroes of Homer to side with us for or against a term which would have tried every Greek tongue in its utterance, and vexed every Greek ear in its hearing; and all the while the bees who rejoice amidst the sugar plantations of our heather warn and welcome each other in songs which the bees of Hymettus sang to each other: and the grasshoppers signal from meadow to meadow as they did of old, when the musical shiver of their wings rang over Greece as its cradle-psalm." And again, speaking of the compass-needle "as the guide of Vasco de Gama to the East Indies, and of Columbus

[1] 'Edin. Univ. Essays,' 1856.
[2] In 'The alleged Antagonism between Poetry and Chemistry.'

to the West Indies and the New World, it was pre-eminently the precursor and pioneer of the telegraph. Silently, and as with finger on its lips, it led them across the waste of waters to the new homes of the world; but when these were largely filled, and houses divided between the old and new hemispheres longed to exchange affectionate greetings, it removed its finger and broke silence. The quivering magnetic needle which lies in the coil of the galvanometer is the tongue of the electric telegraph, and already engineers talk of it as speaking."

" One might almost think that Dr. Wilson was the living analogue of that astronomical fact which he thus describes:[1] " I would liken science and poetry in their natural interdependence to those binary stars, often different in colour, which Herschel's telescope discovered to revolve round each other. ' There is one light of the sun,' says St. Paul, ' and another of the moon, and another of the stars: star differeth from star in glory.' It is so here. That star or sun, for it is both, with its cold, clear, white light, is SCIENCE: that other, with its gorgeous and ever-shifting hues and magnificent blaze, is POETRY. They revolve lovingly round each other in orbits of their own, pouring forth and drinking in the rays which they exchange; and they both also move round and shine towards that centre from which they came, even the throne of Him who is the Source of all truth and the Cause of all beauty."

Contributions to Palæontology. By Prof. JAMES HALL.

Prof. Hall has for some time been in the habit of publishing annually in the Report of the Regents of the University of New York, the more important new species described by him during the year. These reports have the useful purpose of giving early notice of Prof. Hall's discoveries to those who may be working in the same field. We can here only direct attention to those in our hands, that those concerned may take due notice of their contents. The report for 1859-60, relates to species of *Orthis* and *Cyclonema* from the Hudson R. group of Ohio and the Western States, to the distinctions between Bellerophon and some allied genera, with descriptions of new species; to a new genus of shells resembling Cleodera, and named Cleoderma, of which six species are described, and to a number of new species from the

[1] In ' The alleged Antagonism between Poetry and Chemistry.'

Upper Helderberg, Hamilton and Chemung groups. The report for 1860-61, (dated August and September, 1861,) continues the latter subject, and is of much greater length, extending to 84 pages, and containing descriptions of a large number of new forms of gasteropods, cephalopods, and crustaceans, with one annelid and spirorbis.

Explorations and Adventures in Equatorial Africa; with Accounts of the Manners and Customs of the People, and of the chase of the Gorilla, the Crocodile, Leopard, Elephant, Hippopotamus, and other Animals. By Paul B. Du Chaillu; with numerous illustrations. New York: Harper & Bros. Montreal: B. Dawson & Son.

Notwithstanding the suspicion that has been cast upon the integrity of Du Chaillu's statements, and the reality of his explorations, by certain critics in England, the reading public seem to have received the book with confidence and enthusiasm. It has passed through many editions both in England and America, and is read with avidity by all classes of the community. There is an unquestionable truthfulness in the style and substance of the book. It appears as if impossible, that the great part of it could be written by one who had not actually seen what it describes. That there are some confusion and mistake in the dates of the several journeyings recorded is manifest to the careful reader; and the author has himself acknowledged that some of the illustrations were copied, without acknowledgment, from the works of another. With these exceptions nothing has been alleged against the book which cannot be satisfactorily accounted for. There is the fact that Du Chaillu has with him, to verify all his strange accounts of the zoology of the regions in which he travelled, the skins and skeletons of the animals which he hunted and discovered. When one so competent to judge as Owen has recognized the importance of the author's discoveries, and when the British Museum, at Owen's reccommendation, has purchased for their collection some of the rarer and finer specimens, the ordinary reader need have no hesitation in accepting the book as containing a genuine account of the countries professed to have been visited. But even if the book is not true, we can assure our readers that it is worth perusing, inasmuch as it is as curious and interesting as the charming fiction of Robinson Crusoe.

In four years Du Chaillu travelled, unaccompanied with other

white men, 8000 miles through the equatorial regions of Africa. He shot, stuffed, and brought home more than 2000 birds, of which upwards of 60 are new species. He killed above 1000 quadrupeds, of which 200 were stuffed and brought home, with more than 80 skeletons, not less than 20 of which are species hitherto unknown to science. In the course of his travels he suffered 50 attacks of the African fever, endured much famine, was exposed to heavy tropical rains and attacks of ferocious and venomous insects. The book is full of strange incidents pertaining to the customs and habits of the African race. The Cannibal Jans he introduces for the first time to the knowledge of Europeans. They are evidently a fine and hopeful race of people, and with the exception of their liking for human flesh, seem to be more agreeable savages to live among than many of the tribes around them. The author had a proper dread of eating native cookery, fearing, lest unconsciously, he should be feasting upon some portion of a fellow-creature. These races of *colored* people —many of them are not black—have features of character which give much promise. They are by no means destitute of capacity or sense, and their ways of acting in civil and social life are not different from those which we find among people of another skin. Were they only Christianised and civilized they might become a great people, and raise their country to a high place among the nations. This country is yet a virgin ground to the missionary and the trader. The author's aim is to open it up to both. The geographical portion of the work is of great interest. The mountain ranges and the river courses have been noted with precision, and much that is new has been discovered. We commend this book to all readers. To the young it will be " as interesting as a novel," and to the lover of science it will be no common treat.

MISCELLANEOUS.

BOTANICAL SOCIETY OF CANADA.

Regulations for the exchange of Specimens. The laws of the Society provide for the formations of the public herbarium and the extension and improvement of private herbaria. In order to accomplish these important objects, arrangements have been made for receiving from members contributions of dried specimens of

plants, and for supplying in return the desiderata of such members. The following regulations have been framed for regulating the exchange of specimens:

1. The distribution of specimens shall be conducted by the Curators, and shall commence on the 15th November annually, before which time all contributions of specimens must be sent in by members who desire to participate in the distribution.

2. To entitle a Fellow or Subscriber to a share of the Society's duplicate specimens at any of the annual distributions, he shall have transmitted to the Society before the 1st November not less than 50 species of plants, with as many duplicate specimens of the rarer ones as possible.

3. All specimens contributed to the Society must be carefully prepared, by being pressed between sheets of paper in the usual way, but not fastened down to paper in any way. Each specimen is to be accompanied by a lable containing the name of the plant together with the locality where collected, the date of collection, and the collector's name.

4. Universities and societies forming herbaria and corresponding with the Society will be permitted to take precedence of the members in the annual distributions. The Society's public herbarium will be invariably supplied with such specimens as may be required before any distributions takes place.

5. Members are required to send, along with annual contributions of specimens, a list of those species which they desire to receive in return, or otherwise to specify in sufficient explicit terms the nature of the plants wished for.

The above rules will be strictly observed. Foreign botanists, in various parts of the world, have expressed a desire to contribute to the Society's collections. There are spontaneous and liberal offers from Tuscany, Sicily, France, Australia, and other distant parts. It remains for the botanists of Canada to say, by their contributions this autumn, whether the Society will be able to enter upon such advantageous exchanges.

All the communications for the Botanical Society of Canada are to be addressed to Prof. Lawson, Kingston, C.W.

The Areas of Botanical Distribution throughout the central part of British North America.—James Hector, M.D., accompanied the late expedition sent out by the British government, un-

der command of Captain Palliser. Dr. Hector is chiefly known as an able geologist, and the results of his observations have been, in part, published in the English scientific journals. But he is also sufficiently known as a botanist, and was chosen a corresponding member of the Botanical Society of Canada at one of its early meetings. On the 13th ultimo, he read to the Botanical Society of Edinburgh an interesting account of the general features of vegetation in the central part of British America.

Dr. Hector's remarks were of course founded on the botanical results of the late Government expedition. It was accompanied by Mons. Bourgeau as botanist, and the collection made, as named and distributed from Kew, consists of 819 species of flowering plants and ferns, which is nearly one-half the total flora of British North America. An extensive collection of seeds and vegetable products were also obtained by M. Bourgeau, and from the former many interesting and beautiful plants have already been raised for the first time in this country at the Royal Botanic Gardens at Kew. The country from which the collection was made extended from Lake Superior to the Rocky Mountains, and may be divided into four areas, each characterized by its peculiar vegetation. From Lake Superior to Lake Winnipeg is a low mountainous region, covered by an extension westward of the characteristic forest vegetation of Canada. This does not extend far beyond the Red River settlement, however, near which place the oaks true sugar maples, cedar, ash and plane trees cease to be met with, only a few of the ash-leaved maple (Negundo) and the "bastard elm" straggling west in the river courses to the Saskatchewan; but as far as the forest is concerned for the whole distance from Lake Winnipeg to the Rocky Mountains, the "subarctic province," in which the only trees are spruce, scrubby pines, with balsam and aspen poplars and birch, bounds the northern limit of the Central Continental arid tract, which is characterized by the cactus and artemisia. Between the northern zone, which is occupied by extensive morasses and sombre forests of worthless timber, and the arid plains where the tough clay soil being without any vegetable mould to protect it bakes under the heat of the sun in early early spring, so that it only serves to support a sparse growth of wiry grasses and carices, there exists, however, a valuable belt of land from which the timber has been slowly cleared by successive fires. This has arisen from the "Edge of the Woods," the favorite camping-grounds of the Indian Tribes who live by the chase

of the bison; and the great fires which every year start from their encampments and sweep the country have gradually carried the limit of the "Thickwoods" eighty to a hundred miles north of its original position, and thus there has been naturally prepared a valuable and continuous fertile track stretching across the continent, and adapted for easy agricultural settlement. This region is covered with luxuriant natural pasture abounding in vetches and other nutritious plants, and having an undulating surface dotted with groves and clumps of as few poplars, which though worthless as building timber, are yet sufficient for firewood, and add greatly to the beauty of the country. The northern province and the arid tract being the second and third areas, the fourth is that along the eastern base of the Rocky Mountains, where many of the plants of the western slopes of the continent are first met with, among which is the *Douglas pine* and a few others of the pine group. The Alpine region in the Rocky Mountains is from 6500 to 9000 feet above the level of the sea, but it is very variable from their abrupt and craggy aspects. Of fifty plants collected at 8500 feet, fifteen were common alpine forms of the Scotch mountain.

Much of the paper was occupied by a description of the physical geography and meteorology of the region, with a view to show the proper position which its flora occupies in relation to the other botanical areas of the northern part of the continent, and Dr. Hector's views on this subject were explained by reference to a map on which the different areas were coloured. The very marked *representative similarity* was alluded to between the Canadian flora and that of the Pacific coast, many of the forest trees having no well marked specific differences; and as there are no trees of any similar forest growth in the central part of the continent, intermediate in character and position, the inference was drawn that we must look for some other link between those two areas, and which is probably to be found by taking into consideration the oscillations in latitude of the vegetation at different periods, as recently suggested by Dr. Hooker. G. L.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Meeting at Manchester, September, 1861.

(*From the Times of September*, 11*th*.)

The following very interesting Address was delivered by Sir Roderick Murchison as President on opening the Geological Section :—

"Although I have had the honour of presiding over the geologists of the British Association at several previous meetings since our first gathering at York, now 30 years ago, I have never been called upon to open the business of this section with an address; this custom having been introduced since I last occupied the geological chair at Glasgow, in 1856.

"The addresses of my immediate predecessors, and the last anniversary discourse of the President of the Geological Society of London, have embraced so much of the recent progress of our science in many branches, that it would be superfluous on my part to go again over many topics which have been already well treated.

"Thus it is needless that I should occupy your time by alluding to the engrossing subjects of the most recent natural operations with which the geologist has to deal, and which connect his labours with those of the ethnologist. On this head I will only say that, having carefully examined the detrital accumulations forming the ancient banks of the river Somme in France, I am as complete a believer in the commixture in that ancient alluvium, of the works of man with the reliquæ of extinct animals, as their meritorious discoverer, M. Boucher de Perthes, or as their expounders, Prestwich, Lyell and others. I may however express my gratification in learning that our own country is now affording proofs of similar intermixture both in Bedfordshire, Lincolnshire, and other counties, and possibly at this meeting we may have to record additional evidences on this highly interesting topic.

"But I pass at once from any consideration of these recent accumulations, and indeed of all Tertiary rocks; and as a brief space of time only is at my disposal, I will now only lay before you a concise retrospect of the progress which has latterly been made in the development of one great branch of our science. I confine myself then, to the consideration of those primeval rocks with which my own researches have for many years been

most connected, with a few allusions only, to metamorphism, certain metalliferous productions, &c.

"There is, indeed, a peculiar fitness in now dwelling more especially on the ancient rocks, inasmuch as Manchester is surrounded by some of them, while, with the exception of certain groups of erratic blocks and drifts, no deposits occur within the reach of short excursions from hence, which are either of secondary or tertiary age.

"Let us then take a retrospective view of the progress which has been made in the classification and delineation of the older rocks since the Association first assembled at York, in 1831. At that time, as every old geologist knows, no attempt had been made to unravel the order or character of the formations which rise from beneath the Old Red Sandstone. In that year Sedgwick was only beginning to make his first inroads into those mountains of North Wales, the intricacies of which he finally so well elaborated, while I only brought to that, our earliest assembly, the first fruits of observations in Herefordshire, Brecon, Radnor and Shropshire, which led me to work out an order that has since been generally adopted.

"At that time the terms of Cambrian, Silurian, Devonian and Permian were not dreamt of, but acting on the true Baconian principle, their founders and their coadjutors have, after years of toil and comparison, set up such plain landmarks on geological horizons, that they have been recognized over many a distant land. Compare the best map of England of the year 1831, or that of Greenough, which had advanced somewhat upon the admirable original classification of our father William Smith, and see the striking difference between the then existing knowledge, and our present acquirements. It is not too much to say that when the British Association first met, all the region on both sides of the Welch border, and extending to the Irish channel on the west, was in a state of dire confusion; while in Devonshire and Cornwall many of these rocks, which from their crystalline nature were classed and mapped as among the most ancient in the kingdom, have since been shown to be of no higher antiquity than the old red sandstone of Herefordshire.

"As to Scotland, where the ancient rocks abound, though their mineral structure, particularly in those of igneous origin, had necessarily been much developed in the country of Hutton, Playfair, Hall, Jameson and M'Culloch, yet the true age of most of

its sedimentary rocks and their relations, were unknown. Still less had Ireland, another region mainly palæozoic, received any striking portion of that illustration which has since appeared in the excellent general map of Griffith, and which is now being carried to perfection through the labours of the Geological Survey under my colleague Jukes. If such was our benighted state as regarded the order and characters of the older formations at our first meeting, great was the advance we had made, when at our twelfth meeting we first assembled at Manchester in 1842. Presiding then, as I do now, over the geological section, I showed in an evening lecture how the palæozoic rocks of Silurian, Devonian and Carboniferous age, as well as those rocks to which I had assigned the name of Permian, were spread over the vast region of Russia in Europe, and the Ural Mountains. What then are some of the main additions which have been made to our acquaintance with the older rocks in the British Isles since we last visited Manchester?

"Commencing with the oldest strata, I may now assume, from the examinations of several associates on whose powers of observation as well as my own I rely, that what I asserted at the Aberdeen meeting in 1859, as the result of several surveys, and what I first put forth at the Glasgow meeting of 1855, is substantially true. The stratified gneiss of the north-west coast of the Highlands, and of the large island of Lewis and the outer Hebrides, is the fundamental rock of the British Isles, and the precise equivalent of the Laurentian system of Canada, as described by Sir W. Logan. The establishment of this order, which is so clearly exhibited in great natural sections on the west coast of Sutherland and Ross, is of great importance in giving to the science we cultivate a lower datum line than we previously possessed, as first propounded by myself before the British Association in 1855.*

* See Report of British Association for 1855 (Glasgow meeting). At that time I was not aware that the same order was developed on a grand scale in Canada, nor do I now know when that order was there first observed by Sir W. Logan. I then (1855) simply put forward the facts as exhibited on the north-west coast of Scotland—viz., the existence of what I termed a lower or "fundamental gneiss," lying far beneath other gneissose and crystalline strata, containing remains which I even then suggested were of Lower Silurian age. Subsequently, in 1859, when accompanied by Professor Ramsay, I adopted, at his sug-

"For hitherto the order of the geological succession even, as seen in the geological map of England and Wales, or Ireland, as approved by Sir Henry de la Beche and his noble coadjutors, Phillips, Ramsay, Jukes and others, admits no older sediment than the Cambrian of North Wales, whether in its slaty condition in Merioneth and Caernarvon, or in its more altered condition in Anglesea.

"The researches in the Highlands have however shown that in our own islands the older palæozoic rocks, properly so called, or those in which the first traces of life have been discovered, do repose, as in the broad regions of the Laurentian Mountains of Canada, upon a grand stratified crystalline foundation, in which both limestones and iron ores occur subordinate to gneiss. In Scotland, therefore, these earliest gneissic accumulations are now to be marked on our maps by the Greek letter *alpha*, as preceding the Roman *a*, which had been previously applied to the lowest known deposits of England, Wales, and Ireland. Though we must not dogmatize and affirm that these fundamental deposits were in their pristine state absolutely unfurnished with any living things (for Logan and Sterry Hunt in Canada, have suggested that there they indicate traces of the former life,) we may conclude that in the highly metamorphosed condition in which they are now presented to us in North-Western Britain, and associated as they are with much granitic and hornblendic matter, they are for all purposes of the practical geologist, 'azoic rocks.' The Cambrian rocks, or second stage in the ascending order, as seen reposing on the fundamental gneiss of the north-west of Scotland, are purple and red sandstones and conglomerates, forming lofty mountains. These resemble to a great extent portions of the rocks of the same age which are so well known in the Longmynd range of Shropshire, and at Harlech in North Wales, and Bray Head in Ireland.

"At Bray Head they have afforded the Oldhamia, possibly an *alga*, while in the Longmynd in Shropshire, they have yielded to

gestion, the word "Laurentian" in compliment to my friend Sir Wm. Logan, who had then worked out the order in Canada, and mapped it on a stupendous scale. I stated, however, at the same time, that if a British synonym was to have been taken, I should have proposed the word "Lewisian," from the large island of the Lewis, almost wholly composed of this gneiss.

the researches of Mr. Salter some worm tracks and the trace of an obscure crustacean.

" The Highland rocks of this age, as well as their equivalents, the Huronian rocks of North America, have as yet afforded no trace whatever of former life. And yet, such Cambrian rocks are in parts of the Longmynd, and especially in the lofty mountains of the North-western Highlands, much less metamorphosed than many of the crystalline rocks which lie upon them. Rising in the scale of successive deposits, we find a corresponding rise in the signs of former life on reaching that stage in the earlier slaty and schistose rocks in which animal remains begin clearly to show themselves. Thus, the Primordial Zone of M. Barrande is, according to that eminent man, the oldest fauna of his Silurian basin in Bohemia.*

" In the classification adopted by Sir Henry de la Beche and his associates, the Lingula flags, (the equivalent of the 'zone primordiale' of Barrande), are similarly placed at the base of the Silurian system. This primordial zone is also classed as the lowest Silurian by De Verneuil, in Spain; by James Hall, Dale Owen, and others, in the United States, and by Sir. Wm. Logan, Sterry Hunt, and Billings, in Canada.†

" In the last year M. Barrande has most ably compared the

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* I learn, however, that in Bohemia, Dr. Fritzsch has recently discovered in strata lying beneath the mass of the primordial zone of Barrande, and in rocks hitherto considered azoic, the fossil burrows of annelide animals similar to those of our own Longmynd.

† In completing at his own cost a geological survey of Spain, in which he has been occupied for several years, and in the carrying out of which he has determined the width of the sedimentary rocks of the Peninsula (including the Primordial Silurian Zone, discovered by that zealous explorer, M. Casiano de Prado,) M. De Verneuil has in the last few months chiefly examined the eastern part of the kingdom, where few of the older palæozoic rocks exist. I am, however, informed by him that Upper Silurian rocks with *Cardiola interrupta*, identical with those of France and Bohemia, occur along the southern flanks of the Pyrenees, and also re-occur in the Sierra Morena, in strata that overlie the great mass of Lower Silurian rocks as formerly described by M. Casiano de Prado and himself. The southern face of the Pyrenees, he further informs me, is specially marked by the display of mural masses of Carboniferous strata, which, succeeding the Devonian rocks, are not arranged in basin-shape, but stand out in vertical or highly inclined positions, and are followed by extensive conglomerates and marls of Triassic age, and these by deposits charged with fossils of the Lias.

North American Taconic group of Emmons,* with his own primordial Silurian fauna of Bohemia and other parts of Europe; and, although that sound palæontologist, Mr. James Hall, has not hitherto quite coincided with M. Barrande in some details,† it is evident that the primordial fauna occurs in many parts of North America. And as the true order of succession has been ascertained, we now know that the Taconic group is of the same age as the lower Wisconsin beds described by Dale Owen, with their Paradoxides, Dikellocephalus, &c., as well as of the lower portion of the Quebec rocks, with their Conocephalus, Arionellus, &c., described by Logan and Billings, of the crystalline schists of Massachusetts, containing the noble specimens of Paradoxides described by W. Rogers, and of the Vermont beds with their Oleni. It follows that the primordial Silurian zone of Barrande (the lower Lingula flags of Britain) is largely represented in North America, however it may occupy au inverted position in some cases, and in others be altered into crystalline rocks.

"In determining this question due regard has been had to the great convulsions, inversions, and breaks to which these ancient rocks of North America have been subjected, as described by Professors Henry and W. Rogers.

"In an able review of this subject, Mr. Sterry Hunt thus expresses himself:—'We regard the whole Quebec group, with its underlying primordial shales, as the greatly developed representative of the Potsdam and Calciferous groups (with part of that of Chazy), and the true base of the Silurian system.' 'The Quebec group with its underlying shales,' this author adds (and he expresses the opinion of Sir W. Logan,) 'is no other than the Taconic system of Emmons;' which is thus, by these authors, as well as Mr. James Hall, shown to be the natural base of the Silurian rocks in America, as Barrande and De Verneuil have proved it to be on the continent of Europe.

"In our own country a valuable enlargement of our acquaintance with the relations of the primordial zone to the overlying members of the Silurian rocks has been made through the personal examination of Mr. Salter, aided by the independent

* The Silurian classification was proposed by me in 1835, and in the following year, 1836, Dr. Emmons suggested that his black shale rocks which he called Taconic, were older than any I described.

† Nor are the writings of the Professors W. B. and H. D. Rogers in unison with the opinions of the authors here cited.

discoveries of organic remains by MM. Homfray and Ashe of Tremadoc.

"It has been thus ascertained, that the lower member only of the deposit which has hitherto passed under the name of Lingula flags, can be considered the equivalent of the primordial zone of Bohemia. In North Wales that zone has hitherto been mainly characterized by Lingula and the crustaceans Olenus and Paradoxides. Certain additions having been made to these fossils, Mr. Salter finds that of the whole there are five genera peculiar to the lower zone, and seven which pass upwards from it into the next overlying band, or the Tremadoc slate. But the overlying Tremadoc slate, hitherto also grouped with the Lingula flags, is, through its numerous fossils (many of them of recent discovery), demonstrated to constitute a true lower member of the Llandeilo formation. For among the trilobites, the well-known Llandeilo forms of Asaphus and Ogygia range upwards from the very base of these slates. Again, seven or eight other genera of trilobites, which appear here for the first time, are associated with genera of mollusks and encrinites which have lived through the whole Silurian series. Such, for example, are the genera Calymene, Illænus, among crustaceans; the Lingula, Orthis, Bellerophon, and Conularia, among mollusks; together with encrinites, corals, and that telling Silurian zoophyte, the Graptolite. By this proof of the community of fossil types, as well as by a clear lithological passage of the beds, these Tremadoc slates are thus shown to be indissolubly connected with the Llandeilo and other Silurian formations above them; while, although they also pass down conformably into the *zone primordiale*, the latter is characterized by the linguloid shells (Linguella, Salter) and by the genera Olenus, Paradoxides, and Dikelocephalus, which most characterize it in Britain as in other regions.*

"I take this opportunity, however, of reiterating the opinions I have expressed in my work *Siluria*, that to whatever extent the primordial zone of Barrande be distinguished by peculiar fossils in any given tract, from the prevalent Lower Silurian types, there exists no valid ground for differing from Barrande, De Verneuil, Lo-

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*In the last edition of *Siluria* the distinction was drawn between the lower and upper Lingula flags, but the fauna of the latter is now much enlarged.

gan, James Hall, and others, by separating this rudimentary fauna from that of the great Silurian series of life, of which stratigraphically it constitutes the conformable base. And if in Europe but few genera be found which are common to this lower zone and the Llandeilo formation (though the Agnostus and Orthis are common to it and all the Silurian strata), we may not unreasonably attribute the circumstance to the fact that the primordial zone of no one country contains more than a very limited number of distinct forms. May we not, therefore, infer that in the sequel other fossil links, similar to those which are now known to connect the Lower and Upper Silurian series—which I myself at one time supposed to be sharply separated by their organic remains—will be brought to light, and will then zoologically connect the primordial zone with the overlying strata into which it graduates? Let us recollect that a few years only have elapsed since Mr. De Verneuil was criticized for inserting, in his table of the Palæozoic fauna of North America, a number of species as being common to the Lower and Upper Silurian. But now the view of the eminent French Academician has been completely sustained by the discovery in the strata of Anticosti, as worked out by Mr. Billings under the direction of Sir W. Logan, of a group of fossils intermediate in character between those of the Hudson River and Clinton formations, or in other words between the Lower and Upper Silurian rocks. In like manner, a similar interlacing seems already to have been found in North America, between the Quebec group with its primordial fossils, and the Trenton deposits, which are, as is well known, of the Llandeilo age.

"I have thus spoken out upon the fitness of adhering to the classification decided upon by Sir Henry de la Beche and his associates, long before I had any relation to the geological survey, which places the whole of the Lingula flags of Wales as the natural base of the Silurian rocks. For English geologists should remember that this arrangement is not merely the issue of the view I have long maintained, but is also the matured opinion of those geologists, in foreign countries and in our colonies, who have not only zealously elaborated the necessary details, but who have also had the opportunities of making the widest comparisons.

"On the continent of Europe an interesting addition has been made to our acquaintance with the fauna of one of the older beds of the Lower Silurian rocks, or the Obolus green-sand of St. Pe-

tersburg,* by our eminent associate Ehrenberg. He has described and figured † four genera and ten species of microscopic Pteropods, one of which he names *Panderella Silurica*, the generic name being in honour of the distinguished Russian palæontologist Pander, who collected them. It is well to remark, that as the very grains of the Lower Silurian green sand seem to be in great part to be made up of these minute organisms, so we recognize, in one of the oldest strata in which animal life has been detected, organisms of the same nature as, and not less abundant than those which constitute the deep sea bottoms of the existing Mediterranean and other seas.

"Before I quit the consideration of the older palœozoic rocks I must remind you that it is through the discovery, by Mr. C. Peach of certain fossils of Lower Silurian age in the limestones of Sutherland, combined with the order of the strata observed in the year 1827 by Professor Sedgwick and myself, that the true age of the largest and overlying masses of crystalline rocks of the Highlands have been fixed. The fossils of the Sutherland limestone are not, indeed, strictly those of the Lower Silurian of England and Wales, but are analogous to those of the Calciferous sand-rock of North-America. The Maclurea is indeed known in the Silurian limestone of the south of Scotland; but the Ophileta and other forms are not found until we reach the horizon of North America. Now, these fossils refer the zone of the Highland limestone and associated quartz rocks to that portion of the lower Silurian which forms the natural base of the Trenton series of North America, or the lower part of the Llandeilo formation of Britain. The intermediate formation—the 'Lingula flags' or *zone primordiale* of Bohemia—having no representative in the North-western Highlands, there is necessarily a complete unconformity between the fossil-bearing crystalline limestones and quartz rocks with the Maclurea, Murchisonia. Ophileta, Orthis, Orthoceratites, &c., and those Cambrian rocks on which they rest.

"A great revolution in the ideas of many an old geologist, including myself, has thus been effected. Strengthened and confirmed as my view has been by the concordant testimony of Ramsay, Harkness, Geikie, James and others, I have had no hesitation in considering a very large portion of the crystalline strata of

* See "Russia and the Ural Mountains."

† Monats-Bericht der Konig. der Wiss. Berlin, April 18, 1861.

the Highlands to be of the same age as some of the older fossiliferous Silurian rocks, whether in the form of slates in Wales, of grauwacke-schist in the southern counties of Scotland, or in the conditions of mud and sand at St. Petersburg. The conclusions as respects the correlation of all the older rocks of Scotland have now indeed been summed up by Mr. Geikie and myself in the Geological Sketch-map of Scotland which we have just published, and a copy of which is now exhibited. Not the least interesting part of that production, that which explains the age of all the igneous or trappean rocks of the south of Scotland, as well as all the divisions of the Carboniferous formation, is exclusively the work of my able colleague.

"But if, through the labours of hard-working geologists, we have arrived at a clear idea of the first recognizable traces of life and their sequences, we are yet far from having satisfied our minds as to the *modus operandi* by which whole regions of such deposits have, as in the Highlands, been transmuted into a crystalline state. Let us therefore hope that, ere this meeting closes, we may receive instructions from some one of the band of foreign or British geologists who have by their experimental researches been endeavouring to explain the processes by which such wonderful changes in the former condition of the sedimentary deposits have been brought to light; such as that by which strata once resembling the incoherent Silurian clay which we see in Russia have been hardened into such rocks as the slaty grauwacke of other regions, and how hard schists of the south of Scotland have been metamorphosed into the crystalline rocks of the Highlands. But why are British geologists to see any difficulty in admitting what I have proposed, that vast breadths of these crystalline stratified rocks of the Highlands are of Lower Silurian age? Many years ago I suggested, after examination, that some of the crystalline rocks near Christiana in Norway were but altered extensions of the Silurian deposits of that region; and since then Mr. David Forbes and M. Kjerulf have demonstrated the truth of the suggestion. Again, and on a vastly larger scale, we know that in North America all the noted geologists, however they may differ on certain details, agree in recognising the fact that the vast eastern seaboard range of gneissic and micaceous schists is made up of metamorphosed strata, superior even to the lowest of the Silurian rocks. Logan, Rogers, Hall and Sterry Hunt are decidedly

of this opinion; and the point has been most ably and clearly set before the public by the last mentioned of these geologists,* who, being himself an accomplished chemist, has given us some good illustrations of the probable *modus operandi* in the bringing about of these changes.

" The importance of the inquiries to be made by chemical geologists into this branch of our science was not lost upon the earlier members of the British Association. Even in the year 1833 a committee was appointed to endeavour to illustrate the phenomena of the metamorphism of rocks by experiments carried on in iron furnaces. After a series of trials on various mineral substances, the Rev. W. Vernon Harcourt, to whom we owed so much at our foundation, has as the reporter of that committee, been enabled to present to the Association that lucid report on the actual effect of long-continued heat which is published in our last volume. In referring you to that document, I must, as an old practical field-geologist, express the gratification I feel in seeing that my eminent friend has, in the spirit of true inductive philosophy, arrived, after much experiment and thought, at the same conclusion at which, in common with Sedgwick, Buckland, De la Beche, Phillips, and others in my own country, and with L. Von Buch, Elie de Beaumont, and a host of geologists abroad, I had long ago arrived in the field. I, therefore, re-echo their voices in repeating the words of Mr. W. Harcourt, ' that we are not entitled to presume that the forces which have operated on the earth's crust have always been the same.' Looking to the only rational theory which has ever been propounded to account for the great changes in the crust which have taken place in former periods, the existence of an intense central heat which has been secularly more and more repressed by the accumulation of sediment, until the surface of the planet was brought into its present comparatively quiescent condition, our first General Secretary has indicated the train of causes, chymical and physical, which resolve some of the difficulties of the problem. He has brought before us, in a compendious digest, the history of the progress which has been made in this branch of our science, by the writings of La Place, Fourier, Von Buch, Fournet, and others, as well as by the experimental researches of Mitscherlich, Berthier, Senarmont, Daubrée, Deville, De-

* This Journal for April, and American Journal of Science, May, 1861.

lesse, and Durocher. Illustrating his views by reference to chymical changes in the rocks and minerals of our own country, and fortifying his induction by an appeal to his experiments, he arrives at the conclusion that there existed in former periods a much greater intensity of causation than that which now prevails. His theory is that whereas now, in the formation of beds, the aqueous action predominates, and the igneous is only represented by a few solfataras, in the most ancient times the action was much more igneous, and that in the intermediate times fire and water divided the empire between them. In a word, he concludes with the expression of the opinion which my long continued observation of facts had led me to adopt, 'that the nature, force, and progress of the past condition of the earth cannot be measured by its existing condition.'

"In addition to these observations on metamorphism, let me remind you that, on the recommendation of the British Association, other important researches have been carried on by Mr. William Hopkins, our new General Secretary, and in the furnaces of our President, Mr. Fairbairn, on the conductive powers for heat in various mineral substances. Although these experiments have been retarded by a serious accident which befel Mr. Hopkins, they are still in progress, and I learn from him that, without entering into any general discussion as to the probable thickness of the crust of our planet, we may even now affirm, on experimental evidence, that, assuming the observed terrestrial temperature to be due to central heat, the thickness of this crust must be two or three times as great as that which has been usually considered to be indicated by the observed increase of temperature at accessible depths beneath the earth's surface.

"Of the Devonian rocks or Old Red Sandstone much might be said if I were to advert to the details which have been recently worked out in Scotland by Page, Anderson, Mitchell, Powrie, and others; and in England by the researches of the Rev. W. Symonds and other members of the Woolhope and Malvern clubs. But, confining myself to general observations, it may be stated that a triple subdivision of that group, which I have shown to hold good over the continent of Europe as in our own country, seems now to be generally admitted, while the history of its southern fauna in Devonshire has recently been graphically and ably elaborated by Mr. Pengelley in a paper printed in our last volume.

"In Herefordshire and Shropshire the passage of the upper members of the Silurian rocks into the inferior strata of the Old Red group has been well shown by Mr. Lightbody, and the fossils of its lower members have been vigorously collected, while in Scotland Mr. Geikie and others have shown the upward passage of its superior strata into the base of the Carboniferous rocks, and Dr. Anderson announces the finding of shells with crustacea in the lower or gray beds, south of the Tay. I may here note that the point which I have been for some years endeavouring to establish as to the true position of the Caithness flags with their numerous ichthyolites seems to be admitted by my contemporaries. The lamented Hugh Miller considered these ichthyolites as belonging to the lower member of the group, and had good grounds for his views, since at his native place, Cromarty, these fish beds appear very near the base. But, by following them into Caithness and the Orkneys, I have shown that they occupy a middle position, while the true base of the group is the equivalent of the zone with Cephalaspis, Pteraspis, and Pterygotus.

"And here it is right to state that the Upper Silurian rocks, which are clearly represented in Edinburghshire, and which in Lanarkshire seem to graduate upwards into the Lower Old Red or Cephalaspis sandstone, are wanting in the Highlands, thus accounting for the great break which there occurs between the crystallized rocks of lower Silurian age and the bottom beds of the Old Red Sandstone.

"Of the Old Red Sandstone of Scotland and Herefordshire I may be permitted further to observe that its downward passage into the uppermost Silurian rock and the upward passage of its higher strata into the Carboniferous strata has been well developed; the one near Ludlow, chiefly through the labours of Mr. Lightbody; the other in Scotland, through the researches of the Government geologists Howell and Geikie, as well as by those of Mr. D. Page and other observers. On this head I may however note what my contemporaries seem now to admit, that the removal of the Caithness flags and their numerous included ichthyolites from the bottom of this group, and their translation to the central part of the system, as first proposed by myself, is correct. In truth, the lower member of this system is now unequivocally proved to be the band with Cephalaspis, Pteraspis, &c., as seen in Scotland, England, and Russia. The great break which has been traced in

the south of Scotland by Mr. Geikie between the lower and upper Old Red is thus in perfect harmony with the zoological fact that the central or Caithness fauna is entirely wanting in that region, as in England,—as it is indeed in Ireland, where a similar break occurs.

"It gratifies me to add that many new forms of those fossil fishes which so peculiarly characterize the Old Red Sandstone have been admirably described by Sir Philip de Grey Egerton in the *Memoirs of the Geological Survey*, and I must remark that it is most fortunate that the eminent Agassiz is here so well represented by my distinguished friend, who stands unquestionably at the head of the fossil ichthyologists of our country.

"Very considerable advances have been made in the development of our acquaintance with that system—the Carboniferous—which in the North of England (Yorkshire) has been so well described by Professor Philips, and with which all practical geologists in and around Manchester are necessarily most interested. The close researches of Mr. Binney, who has from time to time thrown new lights on the origin and relations of coal and the component parts of its matrix, established proofs, so long ago as 1840, that a great part of our coal fields was accumulated under marine conditions, the fossils associated with the coal beds being, not as had been too generally supposed, of fluviatile or lacustrine character, but the spoils of marine life. Professor Henry Rogers came to the same conclusion with regard to the Appalachian coal fields in America in 1842. Mr. Binney believes that the plant Sigillaria grew in salt water, and it is to be remarked that even in the so-called 'freshwater limestones' of Ardwick and Le Botwood the Spirorbis and other marine shells are frequent, while many of the shells termed Cypris may prove to be species of Cythere. Again, in the illustrations of the fossils which occur in the bands of iron-ore in the South Welsh coal field, Mr. Salter, entering particularly into this question, has shown that in the so-called 'Unio-beds' there constantly occurs a shell related to the Mya of our coasts, which he terms Anthracomya; while, as he has stated in the *Memoirs of the Geological Survey*, just issued, the very Unios of these beds have a peculiar aspect, differing much from that of true freshwater forms. They have, he says, a strongly wrinkled epidermis, which is a mark of the Myadæ, or such burrowing bivalve shells, and not of true Unionidæ; they also differ in the

interior, as shown by Professor W. King. Seeing that in these cases quietly deposited limestones with marine shells (some of them, indeed, of estuary character) rest upon beds of coal, and that in many other cases purely marine limestones alternate frequently with layers of vegetable matter and coal, may we not be led to modify the theory, founded on the sound observation of Sir W. Logan, by which the formation of coal has been rather too exclusively referred to terrestrial and freshwater conditions? May we not rather revert to that more expansive doctrine, which I have long supported, that different operations of nature have brought about the consolidation and alteration of vegetable matter into coal? In other words, that in one tract the coal has been formed by the subsidence *in situ* of vast breadths of former jungles and forests; in another, by the transport of vegetable materials into marine estuaries; in a third case, as in Russia and Scotland (where purely marine limestones alternate with coal), by a succession of oscillations between jungles and the sea; and lastly, by the extensive growth of large plants in shallow seas?

" The geological map of Edinburghshire prepared by Messrs. Howell and Geikie, and recently published, with its lucid explanations, affords, indeed, the clearest proofs of the frequent alternaations of beds of purely marine limestone charged with Producti and bands of coal, and is in direct analogy with the coal fields of the Donetz, in Southern Russia.*

" In sinking through the extensive coal tracts around Manchester (at Dukinfield), where one of the shafts already exceeds in depth the deepest of the Durham mines, rigorous attention will, I hope, be paid to the discovery of the fossils which characterize each bed passed through, not merely to bring about a correctly matured view of the whole history of these interesting accumulations, formed when the surface of our planet was first furnished with abundant vegetation, but also for the practical advantage of the proprietor and miner, who, in certain limited areas, may thus learn where iron-ores and beds of coal are most likely to be persistent. In carrying out his survey work through the north-western coal tracts of Lancashire, to which the large or six-inch Ordnance map has been applied, one of the secretaries of this section, Mr. Hull, has done good service in accurately defining the tracts

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* See " Russia in Europe and the Ural Mountains," Vol. 1.

wherein the elevated coal deposits are covered by drift only, in contradistinction to those which are still surmounted by red rocks of Permian and Triassic age. In seeing that these are eagerly bought by the public, and in recognizing the great use which the six-inch survey has proved in the hands of the geological surveyors in Scotland, our friends in and around Manchester may be led to insist on having that large scale of survey extended to their own important district. By referring to the detailed delineations of the outcrops of all the Carboniferous strata in the counties of Edinburgh, Haddington, Fife, and Linlithgow, as noted by Professor Ramsay and Messrs. Howell and Geikie, the coal proprietors of England will doubtless recognize the great value of such determinations.

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"*Geological Survey and Government School of Mines, Mineral Statistics, and Colonial Surveys.*—As I preside for the first time over this section since I was placed at the head of the Geological Survey of Britain, I may be excused for making an allusion to that national establishment, by stating that the public now take a lively interest in it, as proved by a largely-increased demand for our maps and their illustrations—a demand which will, I doubt not, be much augmented by the translation at an early day of many of our field surveyors from the south-eastern and central parts of England, where they are now chiefly employed, to those northern districts where they will be instrumental in developing the superior mineral wealth of the region.

"The Government School of Mines, an offshoot of the Geological Survey, is primarily intended to furnish miners, metallurgists, and geological surveyors with the scientific training necessary for the successful pursuit and progressive advancement of the callings which they respectively pursue; but at the same time the lectures and the laboratories are open to all those who seek instruction in physical science for its own sake, by reason of its important application to manufactures and the arts. The experience of ten years has led the professors to introduce various modifications into their original programme—with the view of adapting the school as clearly as possible to the wants of those two classes of students; and at present, while a definite curriculum, with special rewards

for excellence, is provided for those who desire to become mining, metallurgical, and geological associates of the school, every student who attends a single course of lectures may by the new rules compete in the final examination for the prizes which attach to it only.

"Throughout the whole period of the existence of the school the professors have given annual courses of evening lectures to working men, which are always fully attended, as a part of their regular duty; and during the past year several of them have delivered voluntarily courses of evening lectures, at a fee so small as to put them within the reach of working men, pupil-teachers, and schoolmasters of primary schools. The professors thus hope to support to the utmost the great impulse towards the diffusion of a knowledge of physical science through all classes of the community which has been given through the Department of Science and Art by the Minute of the Committee of Privy Council of the 2d of June, 1859.

"A body like the British Association for the Advancement of Science should, I conceive, not be unaware of a step of such vast importance, and tending so entirely towards the same goal as that to which its own efforts have been and still are constantly directed.

"Now, inasmuch as I can trace no record of the teachings of the Government School of Mines in the volumes of the British Association, and as I am convinced that the establishment only requires to be more widely known, in order to extend sound physical knowledge not merely to miners and geologists, but also to chemists, metallurgists, and naturalists, I have only to remind my audience that this School of Mines which, owing its origin to Sir Henry De la Beche, has furnished our colonies with some of the most accomplished geological and mining surveyors, and many a manufacturer at home with good chemists and metallurgists, has now for its lecturers men of such eminence that the names of Hoffman, Percy, Warington Smyth, Willis, Ramsay, Huxley, and Tyndall are alone an earnest of our future success.

"In terminating these few allusions to the Geological Survey and its applications, I gladly seize the opportunity of recording that in the days of our founder, Sir Henry de la Beche, our institution was greatly benefited in possessing, for some years, as one of its leading surveyors, such an accomplished naturalist and skilful geologist, as the beloved Assistant General Secretary of the

British Association, Professor Philips, who by his labours threw much new light on the palæontology of Devonshire, who, in the Memoirs of the Survey, has contributed an admirable Monograph on the Silurian and other rocks around the Malvern hills, and who, by his lectures and writings, is now constantly advancing geological science in the oldest of our British Universities.

"There is yet one subject connected with the Geological Survey to which I must also call your attention—viz., the mineral statistics of the United Kingdom, as compiled with great care and ability by Mr. Robert Hunt, the Keeper of the Mining Records, and published annually in the Memoirs of our establishment.

"These returns made a deep impression on the statists of foreign countries who were assembled last year in London at the International Congress. The Government and members of the Legislature are now regularly furnished with reliable information as to our mineral produce, which, until very recently, was not obtainable. By the labours of Mr. Robert Hunt, in sedulously collecting data from all quarters, we now become aware of the fact that we are consuming and exporting about 80,000,000 of tons of coal annually (a prodigious recent increase, and daily augmenting). Of iron ore we raise and smelt upwards of 8,000,000 of tons, producing 3,826,000 tons of pig iron. Of copper ore we raise from our own mines 236,696 tons, which yield 15,968 tons of metallic copper; and from our native metallic minerals we obtain of tin 6,695 tons; of lead, 63,525 tons; and of zinc, 4,357 tons. The total annual value of our minerals and coals is estimated at 26,-993,573*l*., and that of the metals (the produce of the above minerals) and coal at 37,121,318*l*.

"When we turn from the consideration of the home survey to that of the geological surveys in the numerous colonies of Great Britain, I may well reflect with pleasure on the fact that nearly all the leaders of the latter have been connected with, or have gone out from, our home geological survey and the Government School of Mines.

"Such were the relations to us of Sir William Logan in Canada, of Professor Oldham in India, with several of his assistants; of Selwyn in Victoria, of my young friend Gould in Tasmania, as well as of Wall in Trinidad; while Barret, in Jamaica, is a worthy pupil of Professor Sedgwick. Passing over the many interesting results which have arisen out of the examination of these

distant lands, we cannot but be struck with the fact that, while Hindostan (with the exception of the higher Himalayan mountains), differs so materially in its structure and fossil contents from Europe, Australia (particularly Victoria) presents, in its palæozoic rocks at least, a close analogy to Britain. Thanks to the ability and zeal of Mr. Selwyn, a large portion of this great auriferous colony has been already surveyed and mapped out in the clearest manner. In doing this he has demonstrated that the productive quartzose veinstones, which are the chief matrix of gold, are mainly subordinate to the lower Silurian slaty rocks, charged with trilobites and graptolites, and penetrated by granite, syenite, and volcanic rocks, occupying vast regions. Mr. Selwyn, aided in the palæontology of his large subject by Professor M'Coy, has also shown how these original auriferous rocks have been worn down at successive periods, one of which abrasions is of pliocene age, another of post-pliocene, and a third the result of existing causes. All these distinctions, as well as the demarcation of the carboniferous, oolitic, and other rocks are clearly set forth. Looking with admiration at the execution of these geological maps, it was with exceeding pain I learnt that some members of the Legislature of Victoria had threatened to curtail their cost, if not to stop their production. As such ill-timed economy would occasion serious regret among all men of science, and would, I know, be also deeply lamented by the enlightened Governor, Sir Henry Barkly, and would at the same time be of lasting disservice to the material advancement of knowledge among the mining classes of the State, let us earnestly hope that the young House of Parliament at Melbourne may not be led to enact such a measure.

[Want of space compels us to omit the conclusion of this address, as well as a preceding portion relating to the Permian rocks.]

MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF AUGUST, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	8 a. m.	2 p. m.	10 p. m.	8 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					8 a. m.	2 p. m.	10 p. m.
1	20.788	29.729	29.720	67.4	89.8	70.1	.684	.855	.586	.87	.62	.80	E. S. E.	E. S. E.	E. S. E.	5.60	2.0	....	....	C. C. Str. 4.	Clear.	Clear. Faint Aurora Borealis.
2	723	649	543	70.0	84.7	72.2	.621	.870	.706	.85	.73	.90	S. E.	S. by E.	N. W.	31.40	1.5	Inapp.	....	Fog.	C. C. Str. 10.	Cirr. Str. 10.
3	709	753	837	71.4	85.1	68.3	.592	.570	.509	.88	.47	.75	W.	W.	W. S. W.	87.00	1.5	....	....	Clear.	Clear.	Clear.
4	786	608	514	65.2	85.7	78.5	.516	.768	.712	.84	.63	.83	S. E. by E.	S. S. E.	S. S. W.	58.10	2.0	Inapp.	....	"	C. C. Str. 8.	Cu. Str. 4. Thunder.
5	545	614	654	68.1	84.1	64.6	.483	.789	.528	.72	.68	.86	W. N. W.	W.	W.	175.00	2.0	0.310	....	Cu. Str. 10.	Clear.	C. C. Str. 8.
6	710	705	837	60.5	68.3	57.7	.419	.319	.378	.80	.51	.81	W.	W. N. W.	N. by W.	119.80	1.0	....	....	Clear.	Str. 4.	Cu. Str. 4.
7	854	819	890	69.7	78.6	64.6	.345	.619	.497	.68	.64	.83	S.	S. W. by S.	S.	56.40	1.5	....	....	"	Clear.	Str. 4.
8	869	799	826	61.6	76.8	61.1	.383	.497	.419	.71	.59	.80	E. by N.	N. N. E.	S. S. E.	60.80	1.0	....	....	"	"	Clear. Aurora Borealis.
9	784	701	741	60.1	83.0	61.4	.396	.558	.415	.76	.50	.77	E. by N.	S. by E.	S. by E.	11.00	1.0	....	....	"	Cirr. 2.	C. C. Str. 4.
10	488	420	548	68.5	83.6	61.0	.577	.711	.360	.85	.62	.68	W. S. W.	S. W.	S. E. by E.	160.40	1.5	0.290	....	C. C. Str. 4.	Cu. Str. 6.	Clear. Distant Thunder.
11	698	809	818	62.1	78.2	58.6	.334	.704	.387	.86	.73	.79	W. S. W.	S.	W. N. W.	48.70	1.5	....	....	Clear.	Clear.	Clear. Aurora Borealis.
12	897	823	880	53.2	73.4	59.4	.305	.478	.380	.78	.50	.76	N. E. by N.	S. S. E.	N. N. E.	78.10	1.5	....	....	Cu. Str. 4.	Cu. Str. 4.	Cu. Str. 9.
13	891	913	939	54.6	71.0	59.4	.301	.316	.323	.71	.42	.65	N. N. E.	N. E. by E.	N. E. by E.	229.30	2.0	....	....	" 8.	" 6.	" 4. Inapp. faint Hala.
14	990	999	30.060	53.5	71.1	51.0	.295	.386	.252	.73	.53	.68	N. E. by E.	S. S. W.	S. S. W.	224.40	2.0	....	....	" 10.	" 4.	Clear. Aurora Borealis.
15	30.091	30.089	026	49.7	80.2	62.4	.315	.452	.429	.89	.44	.77	S. S. W.	S. S. W.	S. S. W.	60.30	1.5	....	....	Clear. Heavy dew.	" 4.	"
16	29.095	29.941	29.975	58.0	84.8	66.8	.400	.558	.496	.84	.50	.77	S.	S. S. W.	S. S. W.	43.60	1.5	....	....	Clear.	Clear.	Cu. Str. 10.
17	896	846	30.004	64.2	78.8	66.0	.409	.514	.509	.70	.54	.81	S. W.	W. S. W.	S. W.	90.60	1.5	Inapp.	....	Cu. Str. 4.	C. C. Str. 8.	" 10.
18	894	999	29.951	64.1	79.6	65.0	.373	.465	.513	.62	.47	.86	N.	W.	W. N. W.	57.50	1.5	....	....	Cirr. 4.	Cu. Str. 4.	" 10.
19	30.017	999	30.056	58.1	83.1	60.2	.288	.637	.426	.61	.56	.62	N. E. by E.	N. E. by E.	E. by S.	61.10	1.0	....	....	Clear.	Clear.	Cu. Str. 4.
20	082	30.190	151	50.0	76.0	56.6	.318	.376	.363	.74	.42	.81	N. N. E.	E. S. E.	E. by N.	155.50	1.0	....	....	"	Cirr. 4.	Clear.
21	070	045	29.897	56.0	69.3	65.1	.363	.564	.816	.81	.79	.84	E. by N.	S. E.	S. E.	34.70	3.0	Inapp.	....	C. C. Str. 10.	Cu. Str. 4.	Cu. Str. 10.
22	29.612	29.612	615	61.6	69.1	51.9	.498	.564	.410	.91	.79	.84	S. W. by S.	S. S. W.	W.	123.00	3.0	0.680	....	Rain.	" 10.	Clear.
23	853	817	918	53.5	73.6	63.7	.348	.476	.453	.86	.59	.80	W. S. W.	S. W.	W. S. W.	176.61	2.0	....	....	Clear.	" 4.	"
24	903	916	30.004	64.1	76.2	63.0	.446	.652	.510	.77	.73	.88	S. S. W.	S. S. W.	W.	81.75	2.5	0.370	....	"	Clear.	Cu. Str. 6. Distant Thunder.
25	925	982	041	62.0	78.6	68.1	.498	.626	.422	.91	.65	.75	W.	S. S. W.	S. W. by W.	21.20	1.5	....	....	"	Cu. Str. 6.	C. C. Str. 3.
26	30.006	30.035	29.851	65.8	83.5	63.7	.576	.657	.471	.92	.56	.81	S.	S. S. E.	S. by E.	20.20	2.0	0.300	....	C. C. Str. 4.	" 8.	Clear.
27	20.934	29.840	866	65.0	76.1	65.3	.556	.652	.549	.91	.78	.89	S. by W.	S. S. E.	S. by W.	76.00	2.0	Inapp.	....	Cu. Str. 10.	C. C. Str. 8.	C. C. Str. 4.
28	858	818	821	62.4	81.2	68.0	.466	.585	.619	.85	.56	.92	S. W.	S. S. W.	S.	64.10	1.5	....	....	" 10.	Cu. Str. 4.	Cu. Str. 8.
29	865	720	851	63.6	78.6	67.5	.543	.619	.343	.94	.64	.72	S.	W.	S. by W.	88.80	1.0	Inapp.	....	Rain.	Cirr. 4.	Clear.
30	793	708	898	57.7	77.1	59.1	.407	.436	.387	.87	.49	.79	S. S. W.	S. S. W.	W.	62.40	1.5	Inapp.	....	Clear.	Cu. Str. 8.	Cu. Str. 10.
31	850	996	992	40.0	68.4	53.2	.303	.411	.328	.89	.60	.83	W.	W. S. W.	W. S. W.	198.40	1.6	....	....	"	Clear.	Clear.

REPORT FOR THE MONTH OF SEPTEMBER, 1861.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHEE, CLOUDS, REMARKS, &C., &C. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a.m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	30.030	30.017	30.059	49.3	72.2	56.6	.297	.365	.368	.85	.47	.81	W. S. W.	W. S. W.	W. S. W.	32.10	2.0	....	....	Clear.	Clear.	Clear. Aurora Borealis.
2	29.959	29.914	29 851	62.2	68.9	61.0	.376	.502	.473	.87	.72	.88	S. E. by E.	S. S. W.	E. by N.	44.90	2.5	0.386	....	Cu. Str. 8.	Cu Str. 4.	Cu. Str. 10.
3	637	720	889	71.0	81.4	63.0	.651	.585	.453	.88	.56	.80	W. S. W.	S. S. W.	S S. W.	232.10	2.5	....	....	" 4.	" 4.	Clear. Distant Thunder at 6'30
4	882	931	30.021	69.0	65.0	53.7	.358	.307	.315	.73	.51	.77	W.	W.	W. S. W.	230.60	1.5	....	....	Clear.	" 4.	" Faint Aurora Borealis.
5	992	980	29.844	48.6	69.6	55.7	.278	.367	.379	.81	.52	.84	S.	S. by E.	S. S. E.	20.30	2.0	....	....	" Frost.	C. C. Str. 4.	Cu. Str. 2.
6	699	477	582	56.1	74.6	60.1	.398	.568	.462	.90	.67	.91	S. S. E.	E. S. E.	E. S. E.	173.76	2.0	0.300	....	Cu. Str. 8.	Cu. Str. 2.	Clear.
7	850	897	902	56.0	72.4	62.0	.370	.550	.289	.84	.69	.76	S. S. W.	S. S. W.	S. S. W.	214.40	1.6	....	....	" 4.	Clear.	"
8	30.090	30.110	30.170	46.5	61.0	50.1	.280	.352	.290	.88	.70	.82	W. S. W.	S. W.	S. W.	38.10	1.5	....	....	Clear.	Cu. Str. 4.	Cu. Str. 2. faint Aurora Borealis.
9	129	175	150	48.2	68.6	53.0	.285	.349	.303	.85	.51	.77	S.	E. S. E.	S. E.	9.40	1.5	....	....	C. C. Str. 10.	" 8.	Clear.
10	198	114	017	61.0	67.7	56.0	.348	.386	.368	.93	.57	.81	E. S. E.	E. S. E.	E.	9.80	2.0	....	....	" 8.	Clear.	"
11	29.833	20.700	29.662	63.3	57.1	54.1	.321	.378	.399	.80	.81	.93	N. E. by N.	S. S. E.	N.	79.80	2.5	0.156	....	Cu. Str. 10.	Rain.	Cu. Str. 4.
12	624	686	736	52.5	68.4	56.1	.361	.509	.391	.93	.75	.97	S. S. W.	S. S. W.	S. S. W.	132.30	2.0	....	....	" 10.	Cu. Str. 4.	Clear.
13	802	804	914	56.1	75.6	63.0	.427	.584	.422	.97	.66	.76	S. by E.	S.	S. S. E.	118.70	2.6	....	....	Fog.	Clear.	"
14	912	830	808	60.1	75.2	64.2	.432	.745	.563	.85	.86	.94	S. E. by E.	S. E.	S. E.	47.60	2.5	0.066	....	C. C. Str. 4.	Cu. Str. 10.	Rain.
15	700	862	967	68.2	73.6	54.2	.584	.476	.341	.87	.59	.83	S. W.	W. by S.	N. W.	238.10	2.5	....	....	Cirr. 2.	" 4.	Clear. Aurora Borealis.
16	972	30.052	934	41.0	69.6	51.0	.235	.329	.302	.91	.46	.82	S. W. by W.	S. S. E.	S. E. by E.	43.50	1.0	....	....	Clear. Frost.	Clear.	Cu. Str. 10.
17	770	29.799	817	47.5	68.0	52.0	.291	.516	.289	.89	.77	.76	E. S. E.	S. S. E.	S. E. by E.	0.70	1.6	....	....	C. C. Str. 8.	"	Clear.
18	799	823	871	46.2	79.6	65.1	.269	.606	.523	.88	.60	.86	N. E	S. E. by E.	S. E.	17.02	1.5	....	....	Cu. Str. 4.	Cu. Str. 10.	"
19	714	704	683	61.0	78.4	72.0	.449	.628	.601	.85	.65	.78	S. E. by E.	S. S. E.	E. S. E.	205.10	1.5	....	....	Cirr. Str. 4.	Clear.	"
20	842	848	837	57.6	61.7	52.0	.429	.263	.328	.91	.48	.83	W. S. W.	S. by E.	N. E. by E.	42.90	3.0	....	....	C. C. Str. 4.	Cu. Str. 10.	Rain.
21	680	660	756	47.0	48.0	45.0	.291	.310	.282	.69	.92	.96	N. E. by E.	N. E. by E.	N. E. by E.	518.30	4.0	2.646	....	Rain.	" 4.	"
22	763	757	770	46.2	61.0	48.8	.286	.302	.303	.92	.82	.89	N. by W.	S. E. by E.	S. S. W.	184.10	3.0	....	....	Cu. Str. 10.	" 10.	C. C. Str. 8.
23	610	630	707	47.0	69.5	54.0	.309	.464	.369	.96	.79	.90	S. S. E.	W. by S.	S. S. W.	44.40	2.5	0.090	....	Rain.	Clear.	Cu. Str. 10.
24	860	904	991	50.0	69.7	51.3	.290	.592	.321	.82	.83	.66	S. W.	S. W.	S. W. by S.	109.50	1.5	....	....	Clear.	"	Clear. Aurora Borealis.
25	924	993	845	48.0	64.1	55.0	.310	.314	.376	.92	.53	.87	S. S. E.	S. by W.	S. S. E.	38.91	1.5	....	....	Fog.	Cirr. 4.	"
26	770	750	658	50.1	79.1	65.0	.309	.619	.583	.85	.64	.94	S. S. E.	S. S. E.	S. S. E.	91.80	2.0	....	....	C. C. Str. 8.	Cu. Str. 4.	Cu. Str. 1.
27	590	515	303	58.5	58 7	57.8	.476	.423	.459	.97	.88	.97	S. S. E.	S. S. E.	E.	205.70	3.5	1.066	....	Rain.	Rain.	Rain.
28	276	640	643	54.3	55.6	51.0	.390	.259	.328	.92	.68	.69	S. W. by S.	W. S. W.	W. S. W.	178.20	3.0	0.100	....	Cu. Str. 10.	Cu. Str. 4.	C. C. Str. 4.
29	999	30.050	30.198	41.1	50.1	38.6	.212	.309	.201	.82	.85	.88	W. by S.	W. by S.	S. W.	157.40	1.6	Inapp.	....	" 8.	Clear.	Clear.
30	30.270	235	299	40.2	59.0	40.0	.232	.416	.218	.95	.85	.91	S. S. E.	S by E.	S. by E.	8.20	2.0	....	....	" 10.	Cu. Str. 4.	"
...	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	....	....	....	....	....

REMARKS FOR AUGUST, 1861.

Barometer .... { Highest, the 20th day, 30·190 inches. / Lowest, the 10th day, 29.420 " / Monthly Mean, 29.853 " / " Range, 0.770 "

Thermometer ... { Highest, the 1st day, 90°0. / Lowest, the 20th day, 46°2. / Monthly Mean, 66°84. / Monthly Range, 43°8.

Greatest intensity of the Sun's rays, 108°4.
Lowest point of Terrestrial radiation,—41°7.
Amount of evaporation, 3·02 inches.
Mean of Humidity, .736.

Rain fell on 12 days, amounting to 1.950 inches; it was raining 12 hours and 31 minutes, and was accompanied by thunder on 5 days.
Most prevalent wind, the S. S. W.
Least prevalent wind, the N.
Most windy day the 14th day, mean miles per hour, 9.35.
Least winny day the 9th day, mean miles per hour, 0.42.
Aurora Borealis visible on 4 nights.
Solar Haloes visible on 3 days.
The Electrical state of the Atmosphere has indicated rather high intensity.

REMARKS FOR SEPTEMBER, 1861.

Barometer. ...... { Highest, the 30th day, 30.299 inches. / Lowest, the 28th day, 29.276 " / Monthly Mean, 29.849 " / Monthly Range, 1.023 "

Thermometer. { Highest, the 18th day, 79°6. / Lowest, the 25th day,—35°0. / Monthly Mean, 58°06. / Monthly Range, 44°6.

Greatest intensity of the Sun's rays, 97°8.
Lowest point of terrestrial radiation,—32°0.
Mean of humidity, ·804.
Amount of Evaporation, 1·83 inches.

Rain fell on 9 days, amounting to 4·816 inches, it was raining 66 hours, 50 minutes, and Thunder was heard on 1 day.
Most prevalent wind, S. S. E.
Least prevalent wind, E.
Most windy day, the 21st day; mean miles per hour, 31.60.
Least windy day, the 17th day; mean miles per hour, 0.02.
Aurora Borealis visible on 5 nights. On 2 nights the Magnetic disturbance was considerable during its apparition.
The Electrical state of the Atmosphere has indicated feeble intensity.
First Frost occurred on the 5th day.
Solar Haloes seen on 2 days.

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ARTICLE XXX.—*On the recent discoveries of Gold in Nova Scotia.* By J. W. Dawson, LL.D., F.G.S., &c.

(Read before the Natural History Society.)

The discoveries of gold recently made in Nova Scotia, are of much interest both in a geological and commercial point of view; and should they exercise an influence on the destinies of that Province, comparable with that which similar discoveries have produced in California and Australia, they will not be without importance to Canada, and will probably contribute to attract attention to other mineral resources of the Lower Provinces heretofore neglected. In the present paper, I propose to record the leading geological facts connected with these discoveries, using materials collected in my former geological researches in Nova Scotia, and the facts communicated to me by friends who have visited the localities.

In a paper on the Silurian and Devonian rocks of Nova Scotia, published in Vol. V of the *Canadian Naturalist*, p. 132, et seq., I referred very shortly to a series of metamorphic rocks extending along the Atlantic coast of the Province. I stated that it has afforded no fossils; but from its apparent relation to the fossiliferous Silurian rocks further inland, and to the older slate series of

Newfoundland, it may be inferred to belong to the lower part of the Lower Silurian system. The map attached to that paper and here reproduced, shews the geographical position of the beds, which extend along the whole Atlantic coast, from Cape Canso to Cape Sable.

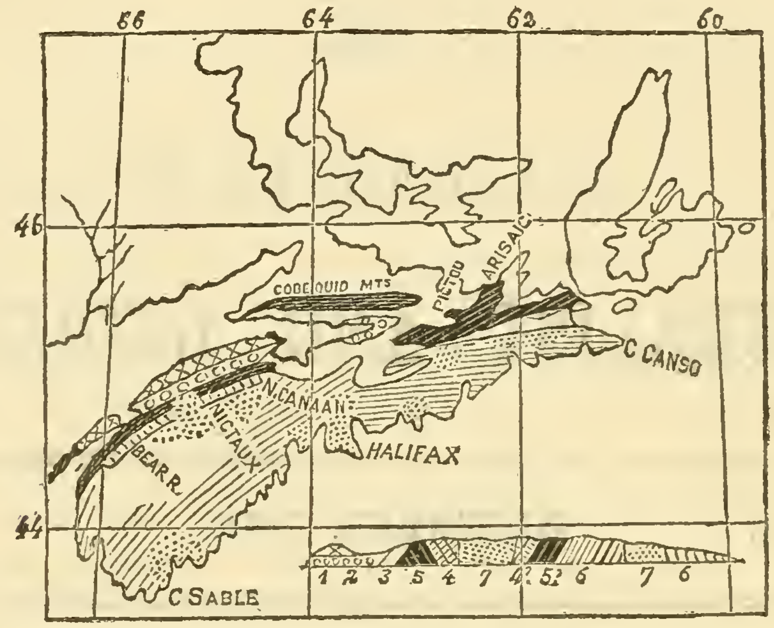

Fig. 1.—*Explanation of the Map and Section.*

(1) Secondary Trap.
(2) New Red Sandstone (Permian or Triassic.)
(3) Carboniferous. (In eastern part of Nova Scotia proper.)
(4) Devonian.
(5) Middle and Upper Silurian.
(6) Metamorphosed Lower Silurian. (Auriferous region.)
(7) Granite.

The numbers refer to the section and to the corresponding shades of the map.

In my "Acadian Geology," (1855) a more full description is given of this "Atlantic Coast Metamorphic District," extending from p. 346 to 365, and including some remarks on the probabilities of the discovery of gold and other metals in this formation. From this description I may condense the following notice of the rocks occurring in the district, and their distribution.

The prevailing stratified rocks are clay slate and quartz rock, the former of various degrees of coarseness, and usually of grey and black tints, and the latter in thick massive beds of a grey colour, locally named "whin." In some localities these are replaced by mica slate and gneiss, perhaps consisting of the same material in a farther state of metamorphism, and they are penetrated by veins and masses of intrusive granite, which from its relations elsewhere, would seem to be of Devonian age.

In passing from S.W. to N.E., and nearly in the strike of the beds, the following distribution appears. In the county of Yarmouth, quartz rock and slate alternate; the former constituting rocky ridges, the latter occurring in the valleys, and occasionally exhibiting beds of chloritic and hornblendic slate. Quartz veins abound in the slates. Along the coast of Shelburne and Queen's counties, granite, gneiss, hard quartzite, and mica slate, prevail; but inland the clay slates occur and occupy a considerable breadth of country. In Lunenburgh and Halifax counties, with the exception of the granitic bands of Aspatogen, Cape Sambro, and Musquodoboit Harbour, the clay slate and quartzite prevail, threaded as usual with small quartz veins, which in some parts of Lunenburgh, and in the country between Halifax and Musquodoboit Harbour, are very numerous and have proved auriferous. Eastward of the granite mass of Musquodoboit and Ship Harbour, the slates and quartzite reappear, and are auriferous, the former, however, being often micaceous, and between Country Harbour and Cape Canseau, presenting many beautiful varieties of perfect mica slates, for specimens of which, I was indebted many years ago to Mr. Whiteman, civil engineer, who visited this coast in connection with the railroad surveys. In the peninsula of Cape Canseau, gneiss appears to prevail, but there are also thick beds of slate, abounding in crystals of chiastolite.

The long range of outcrop above shortly sketched, and extending N.E. and S.W. along the coast, about 250 miles, and inland in some places from 20 to 30 miles, appears to belong to one geological system, and this probably the lower part of the Lower Silurian. It is thus on the geological horizon of the auriferous and cupriferous rocks of Lower Canada, as the age of these rocks has been recently settled by Sir W. E. Logan. These rocks in Canada were until lately referred to the Hudson River group; and on consulting my paper above quoted, and my "supplementary chapter," p. 53, it will be found that I was aware of the similarity in mineral character to these Canadian deposits, though I could not regard the Nova Scotia coast series as of so modern date as that assigned at that time, to what are now regarded as their Canadian equivalents.

No geological survey of Nova Scotia having as yet been made, and the Atlantic coast series, owing to its absence of fossils, and of interesting minerals, being on the whole uninviting to amateurs, little detailed information exists as to the precise order of its de-

posits. When least altered and disturbed, it appears to consist mainly of thick beds of quartzite and slate, alternating with each other, and presenting but little variation of mineral character, except in the greater or less coarseness of the slates, or the quantity of iron pyrites which they contain. The only evidence I have ever obtained of the occurrence of any calcareous rocks in this series, is a small specimen of impure crystalline limestone, which I saw in the possession of the late Titus Smith, many years ago, but he seemed to have no information as to its extent.

The first gold found in this formation was observed at Tangier, a harbour 40 miles east of Halifax, in 1860; but the excitement consequent on its discovery died away, and was renewed only by fresh discoveries in the spring of the present year. I have not visited Tangier, though I have examined portions of the country both east and west of it, and presenting apparently the same geological characters. Indeed the portion of country between Ship Harbour and St. Mary's River, including this place, is perhaps the part of this coast which has been least visited by geologists. I am indebted to Henry Poole, Esq., a corresponding member of this Society, for specimens of the auriferous rock, which seems to be the ordinary slate of the district, somewhat more soft and fine grained than usual, and associated with dark gray quartzite. I have also seen in the possession of Mr. Richardson, of the Geological Survey of Canada, specimens of the rocks, precisely of the same character with those which occur at Musquodoboit, Halifax, Lunenburgh, Northern Queens, and Yarmouth. The gold occurs disseminated in irregular grains and masses in white milky or translucent quartz, often stained by the hydrated peroxide of iron, derived from small quantities of iron pyrites present in the veins. The quartz occurs in small veins traversing the slate, apparently in the direction of its strike, and the gold seems to occur most abundantly at and near the walls of the vein. The gold appears to have been deposited in cavities of the quartz, for in some very rich specimens exhibited in Montreal by the Government Railway Delegation, and in a very fine though small specimen kindly presented to me by the Hon. Mr. Tilley, the gold is impressed by the faces of quartz crystals on which it has been moulded. Mr. Poole has also sent to me specimens of yellow "gossan," or oxide of iron, said to contain particles of gold. This is probably a result of the disintegration of

auriferous iron pyrites. Mr. Poole has also found at Tangier, in quartz veins similar to those containing the gold, small quantities of arsenical pyrites (Mispickel). No other metallic mineral has hitherto, in so far as I am aware, been discovered ; though the analogy of other gold regions would suggest the probability that others may occur.

The Hon. Mr. Howe in an official report to the Lieutenant Governor of Nova Scotia, thus notices the later history of the Tangier " diggings."

" The discoveries made in 1860, your Excellency is aware, were unimportant. Some hundreds of persons, tempted by rumors of the existence of the precious metal, rushed into the woods near the head waters of the Tangier, ten miles from the sea coast, and proved the existence of gold, it is true, but in quantities so small, and such a distance from the roads and navigation, as to promise no return to the most industrious miner. The facts having been investigated and made public, the excitement subsided, and the people returned to their ordinary pursuits.

" In March this year a man, stooping to drink at a brook,found a piece of gold shining among the pebbles over which the stream flowed. He picked it up, and searching found more. This was about half a mile to the eastward of the debouchment of Tangier River, a stream of no great magnitude, taking its rise not very far from the sources of the Musquodoboit, flowing through a chain of lakes which drain, for many miles on either side, a rugged and wilderness country, and falling into the Atlantic about 40 miles to the eastward of Halifax.

" The locality was most favourable for mining operations, being within half a mile of navigation, and surrounded by a hardy population engaged in the fisheries, whose small craft could readily transport everything that the miners would require.

" Though gold was brought to the capital in small quantities in the spring, and some of it exhibited to the Legislature, nobody was sanguine enough to believe that it could be obtained in sufficient abundance to pay for the labor of industrious men, who could earn from four to six shillings sterling per day at almost any other employment. The feeling of the Legislature evidently was, that what might prove a delusion and a snare ought not to be over-estimated ; and that the Government should proceed with caution, that the people might not be misled.

" It was necessary to make some arrangements, however, as per-

sons were rushing in, and the proprietors of the land claimed protection from the Government. Their acquiescence in any policy that might be adopted, was easily obtained, and a deputy surveyor was sent down to Tangier, with instructions to lay off a few lots, 50 feet by 20—to charge a rent of forty dollars for them—to keep the peace, and to report from time to time to the Commissioner of Crown Lands, to whose custody, by the act of last session, the mines of the Province have been transferred.

"Though the rent was high, and the areas small, some lots were taken up by the sanguine and adventurous, led by a few persons who had worked in California and Australia. Though no very great discoveries were made, confidence in the deposits steadily increased, and the pioneers worked on with cheerfulness and industry.

"Until recently only two attempts have been made, at Tangier, to work any but single claims. A small company, headed by William Chambers, Esq., have combined four or five lots, and are running a tunnel through them; and Mr. Robert Sibley, who acquired some experience, and made some money by mining in Australia, has leased from the Government three quarters of an acre, and is sinking a shaft to enable him to work his claim at all seasons of the year.

"The lowest depth yet reached is 45 feet, and the largest nugget found is valued at $300. The gold is got in quartz veins, running through slate or earth resting upon granite, in the form of scales, jagged and torn bits, like shot or bullets fired against a wall. It is sometimes globular, but seldom completely round. The veins run east and west. It is found in the soil immediately around the veins, but placer washing has not been very profitable at Tangier, or perhaps has not been attempted on a scale sufficiently extensive to command a fair return. A new lead has just been discovered, and there is every reason to anticipate that as capital and skill, aided by reliable machinery, accumulate at Tangier, the precious metal will be procured with less labor and yield a more abundant return.

"In other countries the discoveries of gold have attracted mixed multitudes to the mines, of which the reckless and dissolute often form a large proportion. Robbery, riot and murder have characterized these mixed communities, both in California and Australia. A strong police force is required to keep order, the treasure secured can only be transported over the roads, guarded

by mounted escorts; and in the gambling hells of the larger towns, the earnings of the successful are often dissipated in a night. In Nova Scotia, gold mining, like everything else, has developed itself in an orderly and law-abiding spirit. The improvised community at Tangier has been permitted to govern itself. There has been no resident magistrate or policemen, on the ground, during the five months that the mines have been worked. There has not been an act of violence, or a life lost, hardly a blow struck. Two men detected stealing, were drummed out of the settlement, and larceny is unknown. Men sleep and work unarmed, leaving their property secure in their huts; and the roads are as safe in the neighbourhood of Tangier as in the streets of Halifax."

The discoveries at Tangier were followed by others in Musquodoboit, in Laurencetown, and in the vicinity of Halifax. Near Lunenburg also, auriferous veins have been found, and at the latter place a curious and unusual kind of surface deposit has been observed on the beach in front of the auriferous slates, an instance of a gold alluvium actually in progress of formation under the action of the waves.

Still more recently similar discoveries have been made at and near Wine Harbor, fifty miles east of Tangier. Specimens from this place have been kindly forwarded to me by James Primrose, Esq., of Pictou; they are precisely of the same character with those from Tangier, and appear to have been taken from a narrow vein of white quartz in fine grained, glistening, black slate. The following account of the discoveries at this place and the neighbouring harbor is given in a letter accompanying the specimens.

"A fisherman and farmer residing at Indian Harbor and who knew of the Tangier gold, has been prospecting in his own vicinity for about two years, and some weeks ago discovered an auriferous vein of quartz at the shore at Wine Harbor, a little above and very near high water mark. There are no high lands in the vicinity; the surface is covered by a gravelly reddish earth, in some places to the depth of five or six feet, and in others the whin and slate rocks crop out at the surface. Where the first discovery was made these rocks cropped out thus, showing a small irregular vein of quartz which on trial proved auriferous. The strike of the whin rock is pretty regularly south 63° east, and the dip nearly vertical, sometimes inclining a little on either side of the perpendicular. The shores both at Wine and Indian Harbor

are low, and the distance between them, adding the portion which runs parallel to the shore of Wine Harbor, is about $1\frac{1}{2}$ miles.

"The local surveyor has staked out on the surface the strike of the vein, and along its whole length, at intervals, where it has been prospected, gold has been found. The surface is much covered with stones and boulders, consisting of whin of all hues from white to blue, slaty rocks, and large boulders of gray granite, showing in general a considerable quantity of mica. Under those is soil and undulated hard whin, interspersed with slaty rock of various degrees of hardness and in some instances resembling sandstone. At the diggings the *whin rock*, where laid bare, runs south 63° east: close to the side of this occur the quartz veins which are nearly vertical, but irregular and broken; the thickness being from a *line* to one, two, and three inches, with sometimes an irregular mass of quartz yielding gold. On the other side of the quartz occurs the slaty formation, of various degrees of hardness until it approaches nearly the hardness of the whin. This slaty matter, as well as the quartz veins, appear to be much disturbed, the slate however being vertical, and the quartz, in many places, fractured and brittle, and of all shades from white to deep black, although it is always accompanied by some of the white. Scarcely any of the diggers have got beyond the depth which has been disturbed by the action of the elements, and consequently have been able to get a good deal of gold with very common tools, but, when they get deeper, the vein, or rather the rocks enclosing it, become hard, and it will, in my opinion, only yield a profitable result when pursued expensively with the best appliances of practical science."

It thus appears that gold has been found on the south-east coast of Nova Scotia at points 130 miles distant from each other, along the line of strike of the same formation, and there can be no doubt that it will be found more or less abundantly throughout the intermediate country, as well as in the extension of the formation beyond these limits.

In the quartz at Wine Harbor and Indian Harbor arsenical pyrites occurs in the same circumstances as at Tangier, of the deposits at which place these rocks may be considered as merely the continuation eastward.

Many reports have gained currency as to the discovery of gold in the more inland Upper Silurian metamorphic district of the east and middle parts of Pictou, the Cobequid Mountains, &c.;

but hitherto, if the precious metal has really been found in these districts, the quantities appear to have been small. These rocks are of different geological age from those of the coast, so that the occurrence of gold in the latter affords no evidence that it will be found in the former. Yet quartz veins occur in these inland rocks very abundantly, and in slaty rocks not dissimilar from those of the coast, though geologically much younger. It is to be observed also that the age of the veins may be much less than that of the containing rocks, so that the veins of the newer formation may resemble in origin and date those of the older. It is interesting also to note, that heretofore, while the inland or newer metamorphic series has afforded ores of iron and numerous though small veins of copper pyrites, the coast series, until the recent gold discoveries, was regarded as quite barren of metallic minerals, with the exception of iron pyrites. The antecedent probabilities would thus be in favour of the inland series, more especially as copper and gold are associated in Canada. On the other hand, it is quite possible that the older or coast district may alone be auriferous, the newer or inland cupriferous instead.

It has been remarked that it is wonderful that in a district so thickly settled, and so much subjected to the operations of the urveyor, road-maker, and agriculturist, as the south coast of Nova Scotia, so numerous deposits of gold should so long have escaped observation. Geologists also and mineral explorers have repeatedly visited and passed through the district. Still, when it is considered that the country is netted with quartz veins, and that perhaps not more than one in a million of these is appreciably auriferous, the wonder ceases. Ordinary observers do not notice such things. A geologist not specially looking for useful minerals, soon becomes wearied of breaking up and examining barren veins of white quartz, and certainly cannot spare time to spend two years in "prospecting," like the persevering discoverer of the Wine Harbour deposit. My own field notes contain the record of many days of hard work among these unpromising rocks, and countless quartz veins have suffered from my hammer, without yielding a speck of gold. I believe I have visited all the localities of the discoveries, except Tangier, and in some of them, as at the St. Mary's River, Indian Harbour, and Wine Harbour, I have spent days in examining the rocks, not certainly with a special view to the discovery of gold, but often with the assistance of in-

telligent friends who were good observers. The truth is, that in cases of this kind it is difficult to make the initial discovery, but this once made, it is comparatively easy to trace the productive rocks over considerable districts, if the requisite knowledge of the geological character of these has been obtained.

The conditions under which gold occurs in Nova Scotia, are quite similar to those of other auriferous regions. The principal point of difference is the amount of gold found in rock veins, as compared with alluvial wastings derived from their waste—a mere accident of the deposits or of the mode of exploration. It is probable that the Nova Scotia deposits are strictly a continuation of those which run along the eastern Appalachian slope as far as Alabama, and which may throughout, as in Canada and the Ural Mountains, occur in altered members of the Lower Silurian series. It is to be anticipated that the connection with the auriferous deposits of the United States, may soon be effected by the discovery of gold in the metamorphic districts of New Brunswick. The quartz veins of Tangier and Wine Harbour, though small, are remarkably rich in gold; and it still remains to be proved whether, like gold veins elsewhere, they will be found to diminish in productiveness in following them downward.

There is little room to doubt that gold will be found throughout the coast metamorphic district of Nova Scotia: more especially the slaty rocks of southern Greysboro, Halifax, Lunenburgh, and the northern parts of Queens, Shelburne, and Yarmouth, may be expected to be auriferous. In short this applies to all the districts coloured *light blue* in the map attached to my "Acadian Geology." Careful examination may shew that the gold occurs chiefly or entirely, in the veins traversing certain bands of the thick beds of slate and quartz rock in these districts; and these may be recognised by their mineral character, especially if defined in their relation to the other beds by a detailed survey of the productive localities. Still the indications in one locality may not be unfailing when applied to another; and in the mean time it would be the best course for explorers to look at all quartz veins, and especially at those occurring in soft dark slaty beds, particularly near the junction of these beds with other rocks. Further, it would seem that the narrower veins, those following the strike of the rocks, and those stained with iron rust, are most likely to be productive. Minute examination should be made, as gold often occurs in very small grains which may still be suffici-

ently numerous to pay for extraction. Nor should the washing of the sands and gravels in the beds of rivers, and of the alluvial deposits on their banks be neglected, for it may happen in many cases that gold may occur in these, when the veins originally containing it have had their outcrops worn away or concealed. Exploring for gold in new localities cannot be expected to be remunerative, except in rare cases ; but it would be well at least that persons residing in the district above referred to, would embrace such opportunities as may occur, of examining the quartz veins in their vicinity. It is to be hoped that in a short time a geological survey will place within their reach greater facilities than those which now exist, for making discoveries, and improving those already made.

Since writing the above I have received an interesting account of the gold discoveries in Nova Scotia contributed to Silliman's Journal by Mr. O. C. Marsh of the Sheffield Scientific School, Yale College. From this I take the following extracts :—

" The gold at Tangier occurs mainly in the quartz veins, which are in most cases less than a foot in width, but in one instance I noticed it in the argillite near its junction with the quartz. It is disseminated through the matrix in the usual manner,—frequently in isolated particles and masses, and where the quartz is white furnishes specimens of great beauty. One of the largest obtained was prized at three hundred dollars, which was but little above its intrinsic value. Gold has also been found in the soil, and in the bed of a small stream near the mines; but not in sufficient quantity to attract much attention.

" The minerals noticed in association with the gold at this locality were mostly iron pyrites and mispickel. The former appeared to be quite abundant, and, suspecting it to be auriferous, I have examined a specimen and find it contains a considerable quantity of gold. The exact amount was not estimated, but it is sufficient to make its separation profitable if conducted with skill and economy. The mispickel at Tangier is frequently found underlying the gold in the quartz veins, and in some cases enclosing it. Chalcopyrite, magnetite, hematite, and galena, also occur in small quantities.

" Among the specimens of gold obtained at Tangier I noticed three isolated crystals, which resembled in general appearance those brought from California. The largest of these was about one third of an inch in diameter. It was a rhombic dodecahe-

dron with its edges slightly beveled, and although its faces were marked with delicate striæ several of them were unusually brilliant. The other two crystals were octahedrons, with dull and somewhat rounded faces. One of these was flattened and also much elongated. The smallest crystal was about two lines in length and quite perfect.

"At Lunenburg, which is about seventy miles west of Halifax and one hundred and thirty from Tangier,* the gold also occurs in quartz veins traversing the clay slate, which here forms a high bluff, but it is most abundant in the sands of the adjacent beach. Those who first commenced explorations at this place obtained large quantities of gold with very little labor, and their success soon attracted others from all parts of the province. This locality is known in the neighbourhood as "The Ovens," from some deep caverns which have been worn in the bluff by the action of the sea. It is this denuding power which has torn the gold from its bed and collected it on the beach. There is some reason to believe that a large amount of gold derived from the same source exists in the bottom of the harbor, as the sea-weed which is washed on shore has occasionally small particles of the precious metal attached to it. This point will probably soon be decided; as a "Dredging Company" has been formed, and in a short time will commence operations.

"The strata at this place are similar in appearance and structure to those at Tangier, and seem to have been equally disturbed.

"At one point near the shore where they were well exposed the strike was S. 80° W., and the dip about 75° N. Quartz veins pass through the slate in many directions, and are generally found to contain gold, especially those running north and south. Several dikes of basaltic trap were also observed, one of which was seven feet in width and appeared to be conformable to the strata. The auriferous sand on the shore rests on the edges of the upturned slate, which has here been worn out into "pockets" of various sizes, well adapted to retain the gold as it is washed over them. After these cavities have been apparently exhausted a large amount of fine gold can be obtained, for several feet beneath them, between the thin laminæ of the slate.

"Nearly the same minerals which were noticed at Tangier also occur with the gold at this locality. The mispickel is more abundant, and is usually in very perfect octahedral crystals, some

*Only 80 miles in a direct line.—J.W.D.

of which are twins and highly modified. The large amount of this substance in the sand on the beach, makes the gold washing somewhat difficult, and with the rude apparatus employed much of the fine dust is lost. Mercury has not yet been used in separating the gold either here or at the other localities.*

"It is impossible to form any reliable estimate of the amount of gold obtained in Nova Scotia since its discovery there in March last, as in almost every instance the "claims" have been worked by private individuals who were generally disinclined to give information in regard to their own success. Nor would the amount alone, if ascertained, be a fair criterion by which to judge the value of the gold fields, since they have in most cases been explored by those who have had no previous experience in searching for gold, and only the rudest methods have been employed in obtaining it. I was informed that gold to the value of $2400 had been taken from one "claim" at Tangier, $1300 from another, and $480 from a third, although many other "claims" had yielded little or nothing. I saw in Halifax ingots and specimens of Tangier gold which were valued at about $2000, and at Lunenburg at least $250 worth of fine dust which it was said had been washed from a single "pocket" on the beach.

"I have recently analyzed some specimens of gold which I obtained at Tangier and Lunenburg, and the results are given below. The Tangier specimen was taken from a quartz vein, and is very remarkable for its purity. I find it is surpassed in this respect by the gold from only one other locality, viz., Schabrowski, near Katharinenburg, in Siberia.† The Lunenburg gold was in small particles, washed from the sand on the shore. In preparing for the analyses the gold was boiled in chlorhydric acid, fused twice with borax and hammered, and its specific

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* While at Lunenburg I was informed of a circumstance connected with the discovery of the gold which illustrates the utility of even a little scientific knowledge, and the need of its more general diffusion. Some years since a farmer, living in the neighbouring town of Chester, thought he had discovered a valuable copper mine on his land, and at a great expense sunk a shaft about eighty feet in depth. Finding little copper to repay his labor, and having exhausted all his means, the work was finally abandoned. In his excavations he had cut through a large quartz vein richly stored with gold, which he had noticed, but supposed to be merely copper pyrites. The present owner works this copper mine for gold.

† Dana's Mineralogy, Fourth ed., page 9.

gravity taken. The quantity employed in each case was between one and two grammes, and the analyses were made according to the method used by Rose in his investigations on the gold of the Ural mountains.*

"An analysis of the Tangier gold, specific gravity 18.95, gave.

Gold	98·13
Silver	1·76
Copper	·05
Iron	*trace.*
	99.94

"An analysis of Lunenburg gold, specific gravity 18·37, gave.

Gold	92·04
Silver	7·76
Copper	·11
Iron	*trace.*
	99·91

"In some specimens of auriferous quartz from Lawrencetown, obtained of Mr. R. G. Fraser of Halifax, I found mispickel, iron pyrites, galena, and magnetite, associated with the gold in the same manner as at the other localities. In one instance a crystal of mispickel had a small particle of gold passing directly through its centre. The specific gravity of the gold from this place was 18·60, which would indicate a degree of purity between that of the Tangier and Lunenburg specimens. The quantity obtained was not sufficient for satisfactory analyses."

ARTICLE XXXI.—*On the origin of the name 'Canada.'* By Rev. B. Davies, LL.D., Member of the Council of the Philological Society of London.

(Read before the Natural History Society.)

The name by which the most extensive and valuable Province in British America is called, has a very uncertain, if not strictly unknown, origin. To this fact Dr. Trench, in his popular work on "the Study of Words" (p. 170, ed. 9th.), calls attention in these terms: "One might anticipate that a name like 'Canada', given, and within fresh historic times, to a vast territory, would be accounted

* Reice nach dem Urai, page 406. Berlin, 1842.

for, but it is not." Yet there have not been wanting attempts to account for what the learned Dean justly regards as still needing explanation; and the present paper is intended briefly to recount such attempts, and also to submit a new conjecture, not so much with the idea of fully satisfying as of directing inquiry.

Among the curious, who have investigated the early history of Canada, some have sought a native origin for the name, and others a foreign one.

1. Those who hold the name to be aboriginal derive it from the Iroquois language, or rather from a dialect of the same spoken by the Onondagoes, who (as we gather from the *Archæologia Americana*, vol. ii. p. 320) call a town or village *ganataje* or *kanathaje*, while the corresponding words in other Iroquois dialects are said to be *carhata* and *andate* (among the Wyandots) *nekantaa*, (among the Mohawks) and *iennekanandaa* (among the Senecas). It is supposed that Jacques Cartier, who first entered the St. Lawrence in 1535 and discovered the interior of the country, and in whose narrative the name 'Canada' first occurs, but without any explanation, might have heard the natives use the Iroquois word, in one of the above forms, when speaking of their primitive village, then called Stadacona, which stood near Quebec, and that he might have mistaken it for the name of the country and adopted it accordingly without note or comment.* And this is the explanation which appears now to find most favour; and though not satisfied with it myself, I must add that it is somewhat supported—as it has struck me—by the analogy of another term, namely *Canuc*, which is used vulgarly and rather contemptuously for Canadian, and which seems to me to come from *Canuchsha*, the word employed by the Iroquois to denote a 'hut' (see *Arch. Americana*, vol. ii. p. 322). Here a *Canadian* would mean a 'townsman' or 'villager', but a *canuc* would be only a 'hutter'.

2. Others have thought Canada to be a Spanish or Portuguese

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* Cartier gives in his vocabulary *Candata* as the name for village in the Algonquin tongue of Stadacona. In a M.S. dictionary of the Ottawa language in the Library of McGill College, village is represented by the word *outenau*, and house is *ouikwam*, the same with the Micmac *wigwam*, used in Nova Scotia. The word for *hut* in this dictionary is *ouach*, which is perhaps the first syllable of Hochelaga, the ancient name of Montreal; though it is also possible that this name may be derived from *ouatchioua*, mountain or precipice.—(Eds.)

name, derived from *ca* (here) and *nada* (nothing); and so "nothing here" would aptly express the mind of the first explorers when they found no gold or other treasures there to satisfy their greed. Yet it appears that some gold was discovered in the country by the new comers, and geologists now find auriferous deposits in the region south of Quebec, where silver also is to be found, but especially copper. A handful of Canadian gold was shown in the Great Exhibition of the Industry of all Nations in 1851.

3. A third conjecture on this point has occurred to my mind, which may possibly be worthy of attention. I fancy the name may be of oriental origin; for I met some years since with the word *Canada* in a very learned article on the Canarese language and literature in *Zeitschrift der Deutschen Morgenlandischen Gesellschaft* for 1848, p. 258, where the erudite author gives *Canada* as another form of the names *Canara*, and *Carnata*, from which we doubtless get the geographical names Canara and Carnatic in Southern India. The occurrence of the word in such a connection recalled to my mind the fact, that the first discoverers of the New World thought it was part of India, and so its natives were styled Indians and its islands were called the West Indies; and it also suggested to me the possibility, that a part of the mainland was in like manner called Canada in reference to the part of India that was so named, either because the voyagers took it for a portion of India, or because they fancifully chose to transfer the name to the new continent. Most likely other names in America may be accounted for in the same manner, such as *La Chine*, near Montreal, and such as *Chile* in South America, which is also the name of a large Province in China. Martiniere tells us in his Dict. Geographique et Critique, under article *Terre Neuve*, that the Grand Bank of Newfoundland was once called "le grand Banc des Moluques," after the Molucca Islands of the East. And Columbus, it appears, wrote from Haiti, to the king of Spain, saying that he had there found the renowned Ophir (Sopara), with all the treasures coveted by king Solomon. (See Kalisch on Genesis, p. 282).

ARTICLE XXXII.—*An account of the Animals useful in an economic point of view to the various Chipewyan Tribes.* By B. R. Ross, H. B. C. S.

While collecting and arranging a series of specimens of the industrial arts of the natives of McKenzie's River District, for the Royal Industrial Museum of Edinburgh, I was struck, not only with their number, but also with their importance to the domestic comfort of these races.

Though doubtless much of the skill of the Chipewyan tribes has been lost since the period of Sir Alexander McKenzie's visit, by the introduction of European manufactures, enough yet remains to prove interesting as exhibiting the arts and manufactures of a people still in the first stages of social existence and civilization; and the following notices may form a sequel to my paper "On the aboriginal tribes of McKenzie's River District," already printed in the *Canadian Naturalist.* The manufactures are in themselves rude, and, with the exception of porcupine work, I know of none that would obtain the name of art, or win in a Museum, the meed of more than a passing glance from any one, save an ethnologist. To the unreflecting, or to those who for mere pleasure visit these "repositories of science," they must indeed be *caviare*, but to the philosophic mind they would speak volumes, as showing the human intellect, though in its lowest stages, attempting, not unsuccessfully, to break through the surrounding crust of animalism, and struggling to emerge into a sphere of higher intelligence.

In the present sketch, I entirely exclude the Eskimos and Loucheux—though recent researches almost confirm me in the opinion that the latter tribe is a branch of the Chipewyan family—as it would swell the paper much beyond the limits to which I have restricted myself, to pass their handicrafts also in review.

The Chipewyan tribes—including the Montaignais, Yellowknives, Beavers, Dog-ribs, Slaves, Sickannies, Nehaunies, and Hare Indians—draw their resources from the animal, vegetable and mineral kingdoms; but I must at present restrict myself to the first of these great sections, hoping, at some future period, to have the pleasure of noticing the others.

In the manufactures of the Indians, no articles hold a more important or more conspicuous position, than those drawn from animals; but this must naturally be expected in a people who

subsist almost solely on the products of the chase. The climate of these regions moreover in a manner, prohibits agriculture, even were the natives willing to turn their attention to such pursuits, which they are not.

I shall pass briefly in review all the species of animals from which they derive any material, noting with each the various purposes to which it is applied.

Foxes.—(*Vulpes*).

The various species of Foxes found in this District are the red, cross, silver, white and blue. The latter is not, as some writers affirm, the young of the white, nor is it that animal in its summer garb, though it is closely allied to it. The only article furnished by these animals is a fine sinew thread for bead-work, and is taken from the tail.

Black, Grizzly, and Barren-ground Bears.
(*Ursus Americanus, U. horribilis and U. arctos*).

The Black Bear is found throughout the wooded portions of the districts; but is replaced, on the barren grounds, by a species bearing a strong resemblance to the *U. arctos* of Europe. The Grizzly bear dwells among the Rocky Mountains. From the black, and indeed from all, the natives derive food; they also cut the summer hides into cords. The prepared fat is extensively used as a pomatum; but I cannot coincide with those who state bear's grease to be a good hair renovator; on the contrary, it will in all likelihood, if used pure, cause the hairs to split and fall out. Grizzly and Barren-ground bears' claws are much prized for necklaces and coronets, by the Indians.

Marmots.—(*Arctomys*).

There are three, if not four, species of this animal in the McKenzie's River District, viz., *A. pruinosus*—inhabiting the northern Rocky Mountains and Nehaunay Hills—*A. Kennicottii*—dwelling in the same localities, with a more northern range, and extending eastward to the Anderson River—and *A. monax* coming as far north, (though rare) as the Liard's River. Out of all of these, the mountain tribes make robes, and the flesh is counted sweet and fat. As I do not think that the marmot, which I have named *A Kennicottii* (after my friend the enterprising naturalist Mr. Robert Kennicott,) has been yet described, I shall here insert a brief notice concerning it.

It is in size as large as a small musk-rat, and in color a silvery grey, interspersed with orange hairs on the back, but changing on the flanks into a decided yellow, palest on the belly; the tail is short. It has cheek-pouches, and is decidedly smaller than *A. monax.* In habits, so far as is known, it assimilates closely to the other marmots. It is a social animal, and digs its den on the mountain's side, or in the banks of rivers. When these animals are outside, a sentinel is placed at a short distance from their habitations, where it sits on its hams, and will, when surprised, lower itself, uttering a peculiar cry or whistle, that when twice repeated, causes all the party to seek for shelter in their holes. They lay up stores of winter provender. Very far north there is a variety which is perfectly black, instead of hoary and yellow. The robes made from the skins of this species, smell very badly.

Beaver.—(*Castor Canadensis*).

The Beaver exists some distance within the arctic circle; and the darkest colored pelts that I have seen are from Fort Good Hope. The Slave and Dog-rib tribes make capotes and robes out of the skin; and the castoreum is extensively used in the manufacture of a medicine or perfume for enticing the lynx to enter into the snaring cabins. The flesh and tail are among the most prized dainties of Indian epicures.

Porcupines.—(*Erithezon*).

These animals are scattered all over the District, principally in the vicinity of the Rocky Mountain ranges, but I do not think that they are often found around the shores of Great Slave Lake The flesh is considered a great treat, and the quills furnish the materials for embroidering the only really tasteful articles to be found among the natives of these regions. The Slave Indians, dwelling along the McKenzie and Liard's Rivers, are reckoned the most skilful fabricators of this manufacture. The things made out of them consist of belts, bands, garters, bracelets; and they are also used for ornamenting bark-work, dresses, and shoes. In manufacturing belts, &c., a frame-work of sinew thread is first laid, through which the quills are interwoven in squares, something in the manner of Berlin-wool work. The articles when finished are very pretty, and some of the women are sufficiently adepts, to follow any angular pattern which may be set them. The dyes used are procured principally from the vegetable king-

dom, though the natives residing in the vicinity of the Forts often apply to the wives of our servants to tint the quills with imported dye-stuffs.

The Rabbit.—(*Lepus Americanus*).

This animal, so essential to the welfare of the Chipewyan nation, is spread all over the District, except upon the barren-grounds. It is subject to periodical failures, which occur with great regularity, and which cause no small amount of privation and suffering to the Indians, when they happen. When the animals are numerous, the Tinné tribes of the McKenzie valley subsist altogether on them, and the skins furnish almost entirely their winter clothing —robes, shirts, capotes, mittens, and socks being made, which afford a sufficient protection against the most severe cold, though they do not form lasting garments, as the hair falls out very quickly.

The Moose.—(*Alces Americanus*).

Is found, in greater or lesser numbers, throughout the wooded portions of the District. Its food consists of the coarse grass of the swamps, and the shoots of various kinds of willows. It produces from one to two at a birth. In size it is rather larger than a horse, and a buck in its grease will weigh as high as 800 lbs. without the offal. When in good condition the flesh is sweet and tender, and is highly esteemed as an article of food, but should the animal be poor, or have been subjected to violent exertion previously to death, the meat is scarcely eatable. The nose or *moufle* is considered by some the greatest delicacy of the North-west, contesting the palm with Bear's paw, Beaver tail, Reindeer tongue, Buffalo boss, and Sheep ribs. The Indians sometimes snare the Moose; and in the spring, when the action of the sun has formed a thick crust upon the snow, they drive them into drifts and spear them in numbers. It is not a gregarious animal, and to hunt it requires more skill than is necessary in the pursuit of either Reindeer or Buffalo. In the winter, for some time before the hunter comes on his chase, he removes his snow-shoes, and despite the thermometer many degrees below zero, sometimes takes off his leggins; he then makes his approach cautiously, cutting such twigs of willows as may be in his way, with his teeth, and avoiding when possible, dry brush, and fallen timber. As the slightest unusual sound is sufficient to frighten this animal, the chosen period for hunting it is during the continuance of a heavy gale of wind. During the rutting season, which happens in the fall,

the males are rather dangerous to follow, and instances have occurred of native hunters having been severely injured and even killed by them. They fight rather with their fore feet than with their horns.

The uses to which the various parts of the Moose are put, are many. The hide supplies parchment, leather, lines, and cords; he sinews yield thread and glue; the horns serve for handles to knives and awls, as well as to make spoons of; the shank bones are employed as tools to dress leather with; and with a particular portion of the hair, when dyed, the Indian women embroider garments.

To make leather and parchment, the hide is first divested of hair by scraping, and all pieces of raw flesh being cut away, if then washed, stretched and dried, it will become parchment. In converting this into leather a further process of steeping, scraping, rubbing and smearing with brains is gone through, after which it is stretched and dried, and then smoked over a fire of rotten wood which imparts a lively yellow color to it. The article is then ready for service. Of parchment, as such, the Chipewyans make, little use; but the residents avail themselves of it, in place of glass for windows, for constructing the sides of dog-carrioles, and for making glue. The leather is serviceable in a variety of ways, but is principally made up into tents and articles of clothing, and in the fabrication of dog-harnesses and fine cords, wallets, &c. The capotes, gowns, firebags, mittens, moccasins and trousers made of it are often richly ornamented with quills and beads, and when new, look very neat and becoming. The best dressers of leather, in these parts, are the Slave Lake Chipewyans and Liard's River Slaves.

The lines and cords are of various sizes, the largest being used for sled lines and pack-cords, the smaller answer for lacing snowshoes and other purposes. In order to make sled lines pliant—a very necessary quality when the temperature is 40° or 50° below the zero of Farht.—the cord is first soaked in fat fish liquor, it is then dried in the frost, and afterwards rubbed by hauling it through the eye of an axe; to complete the operation it is well greased, and any hard lumps masticated until they become soft, by which process a line is produced of great strength and pliancy, and which is not liable to crack in the most severe cold.

To obtain thread, the fibres of the sinews are separated and twisted into the required sizes. The Moose furnishes the best

quality of this article, which is used by the natives to sew both leather and cloth, to make rabbit snares, and to weave into fishing nets. Sinews can be boiled down into an excellent glue or size.

In mounting knives and awls with the horns, lead, copper and iron are used for inlaying, and rather handsome articles are sometimes produced. The making of spoons, tipping of arrows, and carving of fish hooks requires little explanation nor does the stuffing of dog-collars, and embroidering with the hair need any particular comment, so I shall conclude this imperfect notice of a very valuable animal, what yields food, shelter, and clothing to the savage inhabitants of this remote and dreary portion of the globe.

Reindeer.—(*Rangifer*).

Two species inhabit this District, the Strong-wood (*R. caribou*) and the Barren-ground (*R. arcticus*), which though very nearly allied, are certainly distinct one from the other.

The Strong-wood Reindeer inhabit the thickly wooded parts of the District, particularly among and in the vicinity of the mountain ranges, where they are of very large size. Though smaller than the Moose, these deer are of considerable bulk, and weigh up to 300 lbs. In most particulars they resemble the Barren-ground species, differing from it in the following points :—smaller horns, darker color, larger size, not being so gregarious and not migrating. Both species are equally infested with the larvæ of a kind of gad-fly, which perforate the skins and cause the animals much pain. These larvæ, or others very similar to them, are also found under the mucous membrane at the root of the tongue and in the nostrils, and I have even found them in the brain. The only hides serviceable for converting into leather are those of animals killed early in the winter, which when subjected to a process, similar to that detailed under the head of Moose, and bleached in the frost instead of being smoked, furnish a most beautiful, even, and white leather which is used for shoe-tops, embroidered with quills and silk.

The Barren-ground Reindeer during the summer and spring months frequent the barren plains lying between the wooded country and the shores of Hudson's Bay and the Arctic Sea. Their migrations, which are performed with wonderful regularity, are as follows : They leave the shelter of the woods in the end of March and beginning of April, and resort to the plains where they feed

on various kinds of lichens and mosses, gradually moving northward until they reach the coast, where they bring forth their young in the beginning of June; in July they begin to retire from the sea-board, and, in October, rest on the edge of the wood, where they remain during the cold of winter. In the northward movement the females lead, while the southward migration is almost invariably headed by a patriarchal male. The horns of these deer are much varied in shape, scarcely any two animals having them precisely alike. The old males shed theirs towards the end of December, the young males and barren females in April, and the gravid females in May. Their hair falls in July, but begins to loosen in May. The new coat is darkish brown and short; but it gradually lengthens, and becomes lighter in color until it obtains the slate-grey tint of winter. A full grown buck will weigh about a hundred weight; the flesh when in prime condition is very sweet, but bucks, when in season, have their fat strongly impregnated with the flavor of garlic, which indeed is always present more or less. The summer food of the Reindeer is lichens, moss, and coarse grass; in the winter it consists of the dried hay of the swamps, and the hairy moss adhering to the pine trees. I have seen it stated that these animals in the winter, in order to procure food, shovel away the snow from the ground with their horns, but this theory, however plausible, is entirely negatived by the facts of the case, for from my own knowledge, and all that I can learn, both from whites and natives, these deer use *their feet only* for this purpose. Indeed when the horns would be necessary the males would have already lost them, and a supplemental addition would be required to the hypothesis, of the females clearing a space for the males to graze on, as the gentler sex, at that period, reversing human fashions, wear *the horns* instead of their lords.

The Barren-ground Reindeer furnishes the principal support of the Yellow-knife, Dog-rib, and Hare Indians, and has the same value to them the moose to the other branches of their nation. Their clothing for winter is made out of fawn skins, dressed with the hair on, and consists of capotes, gowns shirts, leggins, mittens, socks, and robes, which are warm, and when new, nice looking. Hides which are so much perforated by the larvæ of the *Æstrus* as to be unfit for any other purpose, are converted into *babiche*, to make which the skin is first divested of hair and all fleshy matter; it is then with a knife cut into the desired thickness, the operation beginning in the centre of the skin. There

are two sizes of this article, the larger being used for barring sleds and for the foot-lacing of snow-shoes, the smaller as a species of thread for sewing leather, for the fine netting of snow-shoes, and for lacing fishing and beaver nets.

The Buffalo.—(*Bos Americanus.*)

The Strong-wood variety, which comes so far north and east as about 20 miles from the mouth of Little Buffalo River, near Fort Resolution, Great Slave Lake, is found most numerously, in the vicinity of the salt plains of Salt River. It is unknown throughout the country inhabited by any of the Slave tribes, and the point mentioned above may be considered as its furthest limits. It is of larger size than the plain variety, of darker color, and more thickly furred. The Chipewyans eat its flesh and make robes and parchment from the hides. The horns are made into powder-flasks and are used for mounting knives and awls; the tail mounted on a wooden shank, ornamented with goose or porcupine quills, is used as a fly-flapper. From its scarcity this animal does not contribute materially to the tribes under consideration.

The Musk Ox.—(*Ovibos moschatus.*)

This small but powerful animal is an inhabitant of the Barren-grounds and Arctic coast, from 61° N. It frequents wild, rocky situations, and possesses the agility of the antelope, between which and the buffalo it appears to form a connecting link. During the winter it feeds on lichens and in the summer on grass. From its remote habit it is of little service to the Chipewyan tribes, and though the Yellow-knives, Dog-ribs and Hare Indians sometimes hunt it, yet as it is very fierce and the flesh is strongly impregnated with the flavor of musk, it is not much looked after. The calf-skins make excellent robes and caps, but the adult hides are almost too hairy for any purpose of that sort. The tails are made into fly-flappers similar to those obtained from the same part of the buffalo.

The Mountain Goat.—(*Aplocerus montanus.*)

Is found throughout all the mountain ranges of this District to within a short distance of the Polar Sea, if indeed it does not reach it. It is a larger animal than the domestic goat, which it resembles only in name and in having a beard. It is covered with long and rather brittle white hairs, beneath which a coat of very fine white curly wool lies close to the skin. The flesh, though rank, is fat and tender, and is much relished by the Mountain

Indians, who also make robes, clothing and leather from the hide. Curious dog-sleds are manufactured out of the skin covering the shank bones, by sewing numbers of the pieces together with the hair outside, which slides well over the snow.

Birds.

From the various snow geese, of which there are three species (*Anser hyperbo*, *A. albatus*, and another as yet unnamed, the "horned wavy goose" of Hearne); from the white and sand-hill cranes (*Grus Americanus* and *G. Canadensis*); from the Canada geese (*Bernicla Canadensis*, *B. leucomelia*, *B. Hutchinsonii*, *B. leucopareia et B. Barnstonii*,); from the trumpeter and wild swans (*Cygnus buccinator et C. Americanus*), and from the white-faced geese (*Anser Gambelii et A. frontalis*), the natives derive the quills so much used for ornamenting round the tops of moccasins, and for similar purposes, as well as for feathering arrows. Fire-bags are made out of the skin of the neck of the great northern diver (*Colymbus torquatus*), and the tail feathers of the golden eagle (*Aquila Canadensis*) are used for head ornaments. The yellow flicker (*Colaptes auratus*), and other gaudily arrayed summer birds yield their plumage for ornamenting dresses. The Dog-rib and Yellow Indians make belts of goose quills by dyeing them and sewing them together in longitudinal stripes.

Here concludes the list of the products derived from the animal kingdom by the Chipewyan tribes; the waters furnishing them with food only. Rude in arts, and debased in manners as are these people, they are among the most kind-hearted and merciful of the Indian races; and would doubtless, if dwelling in a more genial climate, prove the most amenable, of any of the red nations, to the humanizing influences of civilization.

List of Species of Mammals and Birds—collected in McKenzie's River District during 1860-61.

From June 1860 *to April* 1861.

Mammals.	No.	Localities.
1. Sorex.	2	Fort Simpson.
2. Putoreus pusillus.	2	Big Island.
3. " Richardsonii.	2	Fort Simpson and Peel's River.
4. " Noveboracensis.	1	Fort Simpson.
5. " longicauda.	2	Do.
6. Gulo luscus (spare skulls.)	2	Do. and Liard's River.
7. Sicurus Hudsonius.	3	Do. and Big Island.

8. Arctomys monax.	1	Liard's River.
9. " Kennicottii (skeletons.)	5	Ft. Good Hope and Anderson R.
10. Jaculus Hudsonius.	2	Portage la Loche and Yoiecon R.
11. Hesperomys myoides, (Embryos.)	29	Fort Simpson, Good Hope, and Big Island.
12. Arvicola riparia.	5	Fort Simpson, Good Hope, and Big Island.
13. " xanthognathus.	2	Fort Simpson and Slave Lake.
14. Lepus Americanus, (spare skulls.)	1	Fort Simpson.
15. Alce Americanus.	1	Fort Good Hope.
16. Aplocerus montanus.	3	Lapierre's House.
17. Ovibos moschatus, (spare skulls.)	2	Anderson River.

BIRDS.

18. Falco columbarius.	1	Lapierre's House.
19. " sparverius.	1	Do.
20. Astur atricapillus.	2	Big Island and Good Hope.
21. Aquila Canadensis.	1	Fort Simpson.
22. Pandion Carolinensis.	1	Fort Good Hope.
23. Scops asio.*	1	Fort Simpson.
24. Otus Wilsonii.*	1	Do.
25. Surnia ulula?	1	Big Island.
26. Picus villosus.*	4	Fort Simpson.
27. Picoides hirsutus.*	2	Do.
28. " dorsalis.*	1	Do.
29. Sphyrapicus varius?	2	Slave River.
30. Colaptes auratus.	3	Fort Simpson, Peel's River, and Good Hope.
31. Chordiles popitue.	1	Lapierre's House.
32. Ceryle alcyon.	1	Peel's River.
33. Turdus Pallasi.	2	Fort Simpson and Big Island.
34. " Swainsonii, (eggs.)	5	Forts Simpson and Good Hope.
35. Anthus Ludovicianus.	2	Fort Simpson.
36. Sciurus Noveboracensis.	1	Do.
37. Dendroica Townsendii.	2	Big Island.
38. " pinus.	6	Big Island and Fort Simpson.
39. " striata.	2	Fort Good Hope.
40. " æstiva, (eggs.)	2	Big Island.
41. Setophaga ruticilla, (eggs.)	5	Fort Simpson.
42. Cotyle riparia, (eggs.)	2	Do.
43. Collyrio borealis.*	2	Do.
44. Vireo olivaceus.*	1	Do.
45. Parus septentrionalis.*	1	Do.
46. " Hudsonicus.*	1	Do.
47. Eremophila cornuta.	1	Do.

48. Pinicola Canadensis.*	4	Fort Simpson.
49. Ægiothus linaria.*	10	Do.
50. Plectrophanes nivalis.	30	Do.
51. " pictus.	2	Do.
52. Zonotrichia Gambelii, (eggs.)	6	Do. and Fort Good Hope
53. " albicollis, "	3	Do. do. do.
54. " Bairdii, (if new species.)	1	Fort Good Hope.
55. Junco hiemalis.	1	Fort Simpson.
56. Spizella socialis.	4	Do.
57. Melospiza Gouldii.	1	Big Island.
58. Scolecophagus ferrugineus.	2	Fort Simpson.
59. " cyanocephalus.	1	Big Island.
60. Agelaius gubernator.	1	Fort Simpson.
61. Paserella iliaca, (eggs.)	2	Do. and Good Hope.
62. Corvus carnivorus.*	1	Do.
63. Perisoreus Canadensis.*	2	Do.
64. Ectopistes migratorius.	2	Do.
65. Bonasa umbellus.*	1	Do.
66. Lagopus albus.*	2	Do. and Lapierre's House.
67. " rupestris.*	1	Fort Good Hope.
68. " leucurus.*	1	Lapierre's House.
69. Charadrius Virginicus.	2	Do. and Fort Simpson.
70. Ægialitis semipalmatus.	3	Fort Simpson, Big Island, and Slave River.
71. Strepsilas interpres.	1	Big Island.
72. Gallinago Wilsonii.	1	Do. and Fort Simpson.
73. Macrorhamphus scolopaceus.	1	Do.
74. " griseus.	1	Lapierre's House.
75. Tringa Wilsonii.	3	Big Island.
76. " Bonaparti.	2	Do.
77. Calidris arenaria.	1	Do.
78. Gambetta flavipes.	6	Do. and Fort Simpson.
79. Tringoides macularius.	3	Do. do. and Slave River.
80. Netlion Carolinensis.	1	Peel's River.
81. Mareca Americana, (eggs.)	2	Peel's River and Fort Simpson.
82. Bucephala Americana, (eggs.)	1	Fort Simpson.
83. " albeola, (eggs.)	1	Do.
84. Histrionicus torquatus.	1	Lapierre's House.
85. Pelionetta perspicillata.	1	Peel's River.
86. Mergus serrator.	1	Do.
87. Stercorarius pomarinus.	1	Fort Simpson.
88. " parasiticus.	1	Do.
89. " cepphus.	1	Peel's River.
90. Laurus glaucescens, (eggs.)	1	Fort Simpson.
91. " Delawarensis.	1	Do.

92. Rissa septentrionalis.	1 Do.
93. Sterna macrura.	15 McKenzie River, Slave Lake, and Slave River.
94. Columbus torquatus.	5 Fort Simpson and Peel's River.
95. " arcticus.	6 Do. do.
96. " septentrionalis.	2 Fort Good Hope.
97. Podiceps Griseigena.	1 Peel's River.
98. " cornutus.	2 Big Island.

The names are from Prof. Baird's works on North American zoology. The species marked with a star (*) remain during winter. I may have made some mistakes in my identifications, but I do not think many.

B. R. Ross.

ARTICLE XXXIII.—*On the Unity of Geological Phenomena in the Solar System;* by L. Sæmann.

[From the Bull. de la Soc. Géologique de France for Feb. 4, 1861; translated by T. Sterry Hunt, M.A., F.R.S.]

The observations upon the solar eclipse of July 18, 1860, have given rise among astronomers and physicists to some interesting discussions upon the nature of the sun, which seem to merit the attention of geologists. The opinion hitherto generally adopted is founded upon the view suggested by Arago from his observations concerning the spots upon the sun. This great astronomer conceived that by admitting a dark nucleus surrounded by a luminous atmosphere or photosphere, it would be easy to explain the luminous phenomena presented by the sun.* On the other hand Leverrier, from the observations made in Algiers by the scientific commission from the Paris Observatory, maintains that the sun is luminous from the incandescence of its nucleus, and that the variations in the intensity of the light at its surface may be explained by atmospheric perturbations similar to those of our own atmosphere. Mr. Leverrier is led to admit for the sun, at least two atmospheres different in nature and in density, and it is principally with regard to the external envelope, or rose-colored atmosphere, which gives rise to the flames or luminous protuberances, that there exists a difference of opinion among observers.

[* This view of the constitution of the sun, so ingeniously defended by Arago, (see *Annuaire du Bureau des Longitudes* for 1842, p. 510,) is by him there called the theory of William Herschel, who appears to have first clearly defined it.—*Translator*.]

Other observations of a very different nature give a strong support to the conclusions of Leverrier; the remarkable discoveries of Kirchoff and Bunsen upon the dark lines in the solar spectrum, have enabled us to submit the solar atmosphere to an optical analysis which makes known its chemical composition, and shows it to contain several alkaline metals, including sodium and calcium, which can only exist there in the state of gas or vapor. The discussion of this interesting subject belongs especially to chemists and physicists, but geologists may be permitted to express their sympathy for that view which best accords with the theory that forms the basis of their science, and is, moreover, entitled to a certain authority among mathematicians and astronomers, inasmuch as it bears the name of the illustrious Laplace.

All modern geological theories implicitly admit the unity of our planetary system, in so far as that they suppose the sun, the planets and their satellites, to have been formed from one primitive substance; their very variable densities only show that the constituent elements are grouped in varying proportions.* It is not necessary to suppose that each body of the system presents exactly the same chemical combinations as are known on our globe, for affinities will vary with the temperature and the densities of the elements, but we may admit that a portion of any one of these celestial bodies brought to the surface of our earth and there subjected to terrestrial influences, would in obedience to the chemical affinities which here prevail, be at length converted into *a portion of earth.*

This unity of origin once admitted there is no longer any reason for denying the analogy if not the identity, of the phenomena which have accompanied the formation of the sun and the planets, at least of those whose density approaches the nearest to that of the earth. All of them must have passed by cooling from a state of igneous fluidity to a solid condition, and their present state will depend upon the greater or less facility which their volume and their composition will have offered to the passage of heat. The chemical composition being the same, the duration of the geological epochs upon each planet will have been nearly in a direct ratio to its volume, setting aside certain corrections of which it is not necessary at present to discuss the elements. The low density of the sun, which is little greater than that of water (0·252 that

[* Or in different degrees of condensation.—*Translator.*]

of the earth,) would lead us to suppose the existence there of a peculiar condition of things; science has, however, as yet no means of appreciating the action of a heat so excessive as that which is required to maintain the alkaline metals in a gaseous state, and it appears possible that if the temperature of the sun were reduced to that of the earth its density would also be approximated to that of our planet. However this may be, the analogies of Leverrier's theory with the observations of geologists are too important as showing the connection between the two great branches of natural science, not to encourage geologists to further inquiry in the same direction, and it is with this object in view that we have been led to the following reflections.

We admit a similar geological (or chemical) constitution for the various bodies of the solar system, and from this conclude that the phenomena which have accompanied their formation and their successive transformations must have been similar. Thus the planets and satellites whose density is near to that of our earth may be supposed to have passed through the different stages of liquid and solid incandescence, of the successive liquefaction of portions of their gaseous envelopes, and to have finally been the seat of an organic creation.

Of these planetary bodies the best known to us is the moon, and we shall now inquire to what extent our slight knowledge of it is in accordance with the observations made on our earth, and with the present state of the sun as supposed by Mr. Leverrier. It is well known that astronomers, so soon as they became possessed of good telescopes, discovered mountains and plains (or seas) on the surface of the moon, and the immediate application of these names shews the great resemblance which was supposed to exist between the surfaces of the moon and the earth. It does not appear surprising that the form of the lunar mountains should be met with among only a small number of those on our planet, and physicists easily explain the greater elevation and the steep declivities of the former by the comparatively feeble action of the centripetal force at the moon's surface. But one of the gravest objections to the idea of a common origin of the moon and the earth is the apparent absence of water and air from the surface of our satellite, thus seriously embarrassing those geologists who attribute terrestrial volcanic phenomena to the intervention of these expansible elements.

If however we admit for the earth and the moon an identi-

cal and simultaneous point of departure we can understand that their cooling has taken place at a rate nearly proportioned to their volumes. That of the moon being about two hundredths the volume of the earth, its temperature, if we admit an equal conductibility, will have decreased with a rapidity fifty times greater, so that the geological epochs of the moon will have been in the same proportion shorter than the corresponding epochs on the earth, up to the time when the solar heat began to be an appreciable element. The moon has then advanced much more rapidly than the earth in the series of phenomena through which both must pass, and we may therefore logically suppose that our globe will one day offer the same general characters as are now presented by the moon.

We believe then that the water which covers the surface of the earth, and the air which surrounds it will one day disappear, as a necessary consequence of the complete cooling of the interior of our planet. Rocks, with few exceptions, readily absorb moisture, and the more crystalline varieties are the most porous; we need not, however, consider the quantity of water which rocks may imbibe in this way, for the total amount of this element on the earth's surface is so small when compared with the whole mass of the globe, that the ordinary processes of chemical analysis would not detect its presence. If we take the mean depth of the ocean at 600 meters (= 1968 feet), its weight will be equal to one twenty-four-thousandth of the earth, which being reduced to decimals, would give for 100 parts,

Earth, - - - - - - - - -	99·9958
Water, - - - - - - - - -	·0042

In the Bulletin of the Geol. Society of France, (2d series, vol. x, p. 131,) Durocher has published a series of experiments made to determine the quantity of water in those minerals which enter into the structure of rocks, such as the feldspars, micas, hornblende and pyroxene, and which are regarded as anhydrous in composition. These minerals were reduced to coarse powder and exposed to moist air, the proportion of water being determined both before and after; it will be sufficient for our purpose to give the amount of water found after exposure. The orthoclase of Utoë absorbed in this way 0·41 for 100 parts, while the mean of seven other varieties of the same species was 1·28, and that of thirty specimens of various substances 1·27. We have already seen that if the whole of the ocean were to be equally distrib-

uted throughout the earth this would contain only 0·0042, or 100 times less than the least hygrometric of the feldspars. It is probable that the water of the ocean thus absorbed would enter into chemical combination; at all events it would occupy a space much less than the pores produced by the shrinking of the rocks.

If now we attempt a similar calculation for the atmosphere we find that in supposing a height of eight kilometers, the total volume of the air which surrounds our globe, brought to the density which it has at the surface, would be about four millions of cubic myriameters, the volume of the earth being, equal to 1083 millions, or 270 times that of the air, so that a contraction of the primitive volume producing a vacuum of four thousandths ($\frac{1}{250}$) would be more than sufficient to absorb the whole of the atmosphere. (In calculating the volume of the atmosphere we have multiplied the surface of the globe in square myriameters, by 0·8, which gives a sufficiently accurate result, the more so that the density of the air in the interior of the earth will be everywhere greater than at the surface.)

It now remains to be seen whether the assumption of a shrinking of four thousandths can be justified by analogies. In the want of direct determinations of the porosity of crystalline rocks, upon which subject I am not aware of any published experiments, the observation upon the fusion of rocks, and the determinations of their densities in the crystalline and vitreous states admit of an indirect application to the question before us. The experiments of Charles Ste. Claire Deville in the *Comptes Rendus* for 1845, and of Delesse in the *Bulletin* for 1847, agree so closely in this matter that we give them the preference over those of Bischof, published in 1842. Deville and Delesse found that the fusion of rocks yields glasses whose densities are generally inferior to that of the rock in the crystalline state. This diminution for granite is equal to from nine to eleven hundredths, and it is evident that such a glass passing to a crystalline state and retaining its volume, must present vacant spaces in direct proportion to the augmentation of density, that is to say, equal to about one-tenth of its volume. If we take the mean density of granite at 2·60, it might, with such a degree of porosity, imbibe 3·9 parts in 100·0 of its weight of water. This shrinking of one-tenth is no exaggeration, and such a rock would still be a good building material, although containing twenty-five times more vacant space than our calculation requires.

The vitreous state of a body is nothing more than a fixing of its molecules in the positions which belong to them in the liquid state, and probably represents the liquid in its greatest degree of density. The crystallization of barley sugar, of wrought iron and of Reaumur's porcelain, are striking examples of the tendency of molecules to group themselves in crystals, even in the midst of solid masses, and we can thus readily understand the absence of vitreous substances among the older crystalline rocks. The great difficulty is to determine with exactness the proportion of the vacant spaces resulting from this change, since these will vary for each body, and probably also with the volume of the mass. Sulphur fused in an open vessel crystallizes slowly, the level of the liquid sinks a little, and after complete solidification, the surface is covered with hollows resulting from the shrinking, whereas if cooled in a spherical shape these cavities would naturally be formed at the centre. Water and bismuth, as is well known, behave in a very different and remarkable manner, the first dilating eight or ten hundredths at the moment of congelation, and the second one fifty-third. The only conclusion to be drawn from these facts is, that each body in solidification behaves in a different manner, and that for the solution of the question before us, we can only take into account the well known porosity of rocks. The problem, however, appears to me one of great importance in connection with theoretical geology; if we admit with Deville, that at the moment of crystallization, the density of rocks is in all cases augmented, we are forced to conclude that all the crystalline masses formed at the surface of the liquid globe must have sunk and accumulated at the centre. The effect of a similar action has been shown by physicists, who have demonstrated that the cold of winter would freeze our lakes and rivers from the bottom if the ice sunk at the moment of its formation, as would the solidified parts of a lake of molten sulphur. We should then have in place of a liquid globe surrounded by a solid shell, a mass solidified to the centre, a conclusion which is perhaps more in harmony with the feeble and local action which the interior is known to exert on the surface. Since then the data are wanting to fix the amount of shrinking in the crystallization of rocks, we may find in an analogous phenomenon some terms of comparison. The difference between the density of cast metals, and the same after hammering, can only arise from a contraction similar to that which takes place in igneous rocks. The surface

becoming solid while the interior is yet liquid, the natural contraction of this portion is prevented, and from this necessarily result vacant spaces in the mass, which are afterwards compressed by the action of the hammer. In calculating from the differences in density the volume of the vacant spaces thus produced, we find for iron a contraction of 0·075; for nickel 0·045; for aluminum 0·041; for copper 0·011; for gold 0·005; while the contraction of the earth necessary to absorb the whole atmosphere, would be only 0·004. From this it results that an ingot of gold, the most solid obtained by the fusion of a metal, contains more vacant space in proportion to its volume than would be required in the globe for the absorption of its gaseous envelope; it is scarcely possible that any crystalline rock should be wanting in this slight degree of porosity.

From the preceding considerations, the successive absorption of the air and water by the solid portions of the globe, becomes in the highest degree probable, and we may conclude that our earth will one day present that same total absence of ocean and atmosphere which we now remark in the moon. It is evident that this progress of the waters towards the earth's centre must have long been in operation, and it becomes interesting to consider the effect which this must have had upon the level of the ocean. Let us suppose that the rocks near to the surface of the earth contain one hundredth of water, a proportion which from the above calculation will not be regarded as excessive, and that the water moreover does not exist in this proportion at a depth beyond that at which the terrestrial heat equals 100 degrees centigrade. If we take the augmentation of heat in descending to be one degree for thirty-three meters, this will give a depth of about 3000 meters, while one part of water by weight in one hundred parts of a rock whose density is equal to 2·5, will correspond to a volume of one-fortieth. We shall now calculate the volume of this external layer which we have supposed to be thus impregnated with water, regarding it as a prism having for its base the surface of the earth, with a height of 3000 meters, which would give a mass of 1,530,000 cubic myriameters, containing 38,000 cubic myriameters of water. The total volume of the ocean being one-forty-eighth thousandth that of the globe, or 225,000 cubic myriameters, it follows that this layer of 3000 meters of earth would contain a volume of water equal to one-sixth of the present ocean. Whatever may be the real value of

these figures, which we have adopted to render the demonstration more clear, the interest and importance of this inquiry is evident.

I am convinced that the ultimate complete cooling of the interior of the earth is inevitable. We may affirm on general principles, that between two media of different temperatures, separated by a layer of rock which is a conductor of heat, an equilibrium will at length be established. It is probable that this cooling is however to a great extent effected by the innumerable currents of water and gases which circulate in every direction through the interior of the globe, and of which volcanic eruptions, hot springs and *suffioni* are only the more violent manifestations attaining the earth's surface. The recent ingenious experiment of Daubrée has shown us that water may be drawn by capillary force towards spaces heated much above its boiling point. The water thus conveyed, in passing into the state of vapour does not everywhere produce volcanic phenomena, for these probably require the concurrence of conditions which are not often found. The aqueous vapour will ordinarily ascend to colder portions of the earth's crust, and there yielding its heat to the walls of the fissures, will flow back in the liquid state to the source of heat, to repeat the same process, while on the other hand currents of cold water will absorb the heat thus conveyed to the rocks and bring it to the surface by thermal springs.

The general permeability of rocks is so well admitted by most geologists that I have not thought it necessary to seek for proof of it in the discussions of the present question ; the brilliant conception of the metamorphism of rocks by the humid way, which has been, so well maintained by the ablest chemists, is only possible on this condition. The permeability of rocks also explains in a satisfactory manner the formation of agates, and of zeolites, arragonite and other minerals in the midst of the most compact basalts, and of geodes of quartz in the Norwegian granites. We may also recall the artificial colours which are given to agates. Mr. Damour has even shown by a series of curious experiments that the water which is ordinarily considered as chemically combined in certain hydrated silicates, such as zeolites, may be in part extracted from them, and again restored, without any apparent alteration in these minerals.

ARTICLE XXXIV.—*On the Land and Fresh Water Mollusca of Lower Canada, with thoughts on the general geographical distribution of Animals and Plants throughout Canada.* By J. F. Whiteaves, F. G. S., Honorary member of the Ashmolean Society of Oxford, &c., &c.

(Read before the Natural History Society of Montreal.)

Our knowledge of the land and fresh water mollusca inhabiting Canada generally, is very limited. The papers published by Mr. Bell and Mr. D'Urban in the Canadian Naturalist, together with another in the Canadian Journal by Mr. Williamson, contain all the published information on this subject. During the past summer, (1861) I have given the whole of my time to the investigation of these creatures in Lower Canada, and have obtained some additional information respecting them, which I propose bringing before the public in this paper.

The result of about five months collecting, principally in the neighbourhood of Quebec and Montreal, has been the discovery of nineteen species previously unknown in Lower Canada. They are for the most part well known New England species, which had not previously been detected so far north as Canada. Four of these are land, and fifteen fresh water shells. Of the land shells, the first is, it would seem, an indubitable alien,—the Helix rufescens of Muller, a small snail, common enough in Great Britain, but which has not hitherto been found on the American continent. During my stay at Quebec, I found it living in abundance on that part of the plains of Abraham, known as the Cove Fields.

On the island of Orleans, another rare and beautiful little snail occurred to me, also alive,—the Helix capsella of Gould, which has been hitherto only found in the state of Tennessee. Living about decayed logs, under small pieces of timber washed ashore, on trunks of smooth trees and under stones,—observed only by the prying eye of the naturalist,—occur sundry little snails, with cylindrical shells, the apertures of which are generally armed with teeth. Owing to the general resemblance of these shells to a small chrysalis, they have received the generic name of Pupa. Of this group two species (Pupa simplex, Gould, and Vertigo Gouldii, Binney) were previously known to inhabit Lower Canada from the researches of Messrs. Bell and D'Urban. To this number I can add two species, Pupa armifera, Say, which lives in quantities under stones on the plains of Abraham, and Pupa contracta, Say, which I found on the island of Orleans. The extremes

of heat and cold, together with the dryness of the atmosphere in Canada seem unfavourable to the abundance of land snails. Hence we must not expect, perhaps, to find many novelties among the terrestrial mollusca, except among the small and critical species. But in this land of lakes and mighty rivers, which may almost be said to be unexplored, many interesting fresh water shells may yet be obtained.

Of the Unionidæ, four species new to the published lists, have occurred to me in Lower Canada. Three of these are New England species, while the other was described from the Ohio river.

In the rivers, lakes and swamps, throughout the whole province, living in the sand or mud at the bottom, there occur small bivalves of the genera Cyclas and Pisidium. The chief difference between Cyclas and Pisidium is that in Cyclas the two siphons are distinct, while in Pisidium the siphons are united into a single tube. The shell of Cyclas is nearly equilateral, while that of Pisidium is very oblique. These creatures are most abundant everywhere, but, comparatively speaking, very little is known respecting them. I have eight species not previously recorded as Canadian, while in the proceedings of the Boston Natural History Society, ten species new to science are recorded from the neighbourhood of Lake Superior. I would call special attention to these little shells; the fact of no less than eighteen species having been left out in all the catalogues of land and fresh water shells in the Canadian Naturalist, would seem to shew that our rivers and lakes may contain many rare and curious forms which have yet to be detected.

The remaining three species are Limnæa columella, Planorbis armigerus and P. deflectus; three fresh water snails, mostly critical forms, which have been previously overlooked. A most remarkable fact in connection with these fresh water snails, is that no less than nine species, a large proportion of the whole, occur on both the Atlantic and Pacific coasts. It has been held by many naturalists, that a lofty mountain chain will form an obstacle to the migration of species. Yet here we find that on each side of a mountain barrier, some of the peaks of which are as much as 15,000 and 16,000 feet above the level of the sea, and clothed with perpetual snow, such sluggish creatures as fresh water mollusca both can and do exist, the species in each case being identical. It would seem at any rate, that there are exceptions to this rule, and that the Rocky Mountains, for example, do not present an insuperable obstacle to migration.

But if we call in the aid of geology, we shall find that, in all probability, this great mountain barrier is of later date than the fauna and flora existing around it. It should be stated too that the fresh water Pulmonifera are remarkable for their world-wide distribution.

The laws which affect the geographical distribution of plants and animals on the surface of our planet, are creating much interest just now in the minds of scientific men. Analogy it has been said favours the supposition that each species whether animal or vegetable was originally formed in some particular locality, whence it spread itself gradually over a certain area; rather than that the earth was at once, by the fiat of the Almighty, peopled as we at present behold it. The majority of our best naturalists are inclined to accept the theory that every species has originated from a common centre, and that numerous such centres were situated in different parts of the world, each centre being the seat of a particular number of species. In accordance with this view, Mr. Woodward, in his admirable treatise on recent and fossil shells, has mapped out the whole globe into molluscan provinces, each of which he supposes to possess a certain number of shells peculiar to it, and to be characterized by definite groups of this class of animals. Prof. Schouw, of Berlin, has carried out the same idea in the vegetable kingdom; but the views of these two gentlemen do not exactly correspond. Mr. Woodward divides the eastern part of North America into two regions, characterized, according to his views, by a peculiar assemblage of land and fresh water shells. One of these he calls the Canadian region, which includes the whole of Upper and Lower Canada;—and the other the Atlantic region, which comprises all the United States east of the Missisipi valley. In Europe generally, even at the present date, but little is known respecting the natural history of Canada. Hence Mr. Woodward's data were hardly sufficient to enable him to generalize with much confidence. He remarks, "the country drained by the great lakes, and the river St. Lawrence possesses very few peculiar shells, and those mostly of fresh water genera. It is chiefly remarkable for the presence of a few European species, which strengthen the evidence of a landway across the Atlantic having remained till after the epoch of the existing animals and plants."

This landway I propose to say a few words about presently. And here, it may be observed, that of all the land snails which are common to both sides of the Atlantic, very few can be proved

to be really indigenous to America. Now, with one exception, all the shells of both Upper and Lower Canada also inhabit the Atlantic region. The little group of fresh water bivalves, to which I endeavoured previously to draw some attention, forms this exception. Eight species of Cyclas and three of Pisidium are, so far as we know at present, peculiar to Canada, and have never been found elsewhere. But these little shells require to be carefully searched for, and are very similar one to an other; hence they may have been overlooked in the New England states.

When we turn to the sister science of botany, we shall find that somewhat different views of geographical distribution have been entertained. If we compare our knowledge of Canadian plants with Prof. Schouw's theories respecting the general geographical distribution of the vegetable kingdom we shall see that in Canada two botanical provinces meet. The first is the well-known Arctic flora, which is characterized by the abundance of mosses, Saxifrages, Gentians, species of Silene, Arenaria, and Dianthus; and also by the presence of many species of willow and sedges.

As defined by Prof. Schouw, the total absence of tropical families, a notable decrease of the forms peculiar to the temperate zone, and the prevalence of forests of firs and birches, form additional characteristics of this region. Geographically, it includes all the countries within the polar circle, with some parts of Europe, Asia and America to the south of it; as for example, the mountains of Scotland and Wales, Labrador, Greenland, and the northern part of Canada. Next we have what Prof. Schouw calls the region of Asters and Solidagos, characterized by the great variety of oaks and firs, the small number of Umbelliferæ and Cruciferæ, by the almost total absence of true heaths, which are here replaced by Vacciniums, and by the abundance of the said Asters and Solidagos. Geographically it includes Mr. Woodward's Atlantic region, and the southern part of Canada. Thus, judging from the distribution of Mollusca, Mr. Woodward thinks that Canada should rank as a distinct natural-history region, while on the contrary, judging from the evidence afforded by the vegetable kingdom,—according to Prof. Schouw's theory, part of Canada belongs to an Arctic, and part to an Atlantic region. But here again we must not neglect to inquire what light the geology throws upon this question, and turning to the geologic record, we shall find that since the first appearance of these animals and plants on the surface of our globe, great alterations in the relative distribution of land and water and a general subsi-

dence and re-upheaval of the continents of Europe and America, have been effected. We shall do well to remember the brilliant generalizations of the late Edward Forbes, after a close study of the distribution of animals and plants in Great Britain, and of their connection with the tertiary deposits of the same country.

On the tops of the mountains near the lakes of Killarney, in the south of Ireland, occur a few plants, entirely different from those of the Scotch and Welsh mountains, but nearly agreeing with those of the Asturian mountains in the north of Spain. According to Forbes, the southern character of these Irish plants, and their extreme isolation, point to a period when a great mountain barrier extended across the Atlantic, uniting Ireland with Spain. Soon after this, arguing from similar data, he infers that another barrier connected the west of France with the south-west of England and thence to Ireland;—and a little later England and France were connected by dry land, towards the eastern part of the Channel. Upon this supposition it is easy to understand why two small snails (the Helix incarnata and Bithinia marginata,) which abound as Pleistocene fossils in the valley of the Thames, although extinct in Great Britain, are still found living in France.

At the time of the glacial drift, what are now the summits of the Scotch and Welsh mountains were then—Forbes argues—low islands, or members of chains of islands, extending to the area of Norway, through a glacial sea—clothed with an Arctic vegetation, which in the gradual upheaval of those islands, and consequent change of climate, became limited to the summits of the new formed and still existing mountains. After this upheaval it is believed that Ireland was connected with England, and England with Germany, by vast plains, fragments of which still exist, and upon which lived the Irish elk, two-horned rhinoceri, the Arctic elephant (Elephas primigenius), and other quadrupeds now extinct, but which have left behind them in the gravels of our English drift, unmistakeable evidence of their having at one time roamed in great numbers over what is now Great Britain.

The array of facts which tends to corroborate Forbes's theories would occupy too much time to explain in detail;—I have merely stated his general views in so far as they affect the question at issue. Carrying out these well known generalizations, Sir Charles Lyell after visiting this country and studying the peculiar distribution of Pleistocene fossils in Lower Canada, published a theory which he thought would account for these phenomena. This

was that the land in North America, "after it had acquired its present outline of hill and valley, cliff and ravine," was subjected to a gradual submergence—and that at a subsequent period it re-emerged from the ocean. Again, it is a well-known fact, that more than half of the marine shells of the northern New England states, and also of the Gulf of the St. Lawrence are common to the seas of northern Europe. This has been held, with much probability, to prove the existence of a landway across the Atlantic since the epoch of the still living animals and plants.

It should be stated that many American shells, which are not now known to inhabit the European seas, occur fossil in the red crag of Great Britain—this would tend to prove the great antiquity of the existing fauna.

If too the Helix labyrinthica (a little snail common in Canada) be, as many of our best naturalists think, identical with a fossil species from the Eocene beds of the Isle of Wight, it is just possible that some of our land shells may prove to be even of still older date. It has been noticed by scientific men in Britain, that these fossil land shells from the Isle of Wight are of a group quite American in character. Neither should we forget the theory that at a period somewhat later geologically than these Eocene beds, the isthmus of Darien, or some portion of it at least, was submerged, and we should take into consideration the supposed consequent alteration of the currents of the gulf stream. It has been suggested that from this cause alone, the climate of Great Britain was then as cold as that of the island of Newfoundland at the present day.

But here in Canada, our knowledge of facts is much too meagre and unsatisfactory to enable us to generalize either on the distribution of plants and animals in British America, or on the connection between existing animals and the tertiary formations of this country. The deposits of land and fresh water shells in our lacustrine marls, require to be carefully worked out. and catalogues of the species which they contain to be published. In the living land and fresh water mollusca, much is yet to be done; —the neighbourhood of Lake Superior may yet produce many new fresh water forms, while the vicinity of Toronto, and that part of Canada to the south-west of Lake Erie are, conchologically speaking, almost unknown. The opening up of canals has caused a northward emigration of fresh water shells, and by this means several species have been enabled to travel from Ohio into the south-west peninsula of Canada. In my own private collection,

I have six fresh water shells hitherto not known to inhabit Canada, which have been introduced in this way; five are from the Welland Canal, and one is from the Thames river at Chatham, C.W.; they are all well-known Ohio shells. The object of this paper has been a suggestive one, and if by these few remarks I shall have attracted attention to the interesting subject of our land and fresh water shells, my labour will not have been in vain.

List of land and fresh water shells hitherto not known as inhabiting Lower Canada.

Anodonta undulata, Say. St. Charles River, near Quebec.

Anodonta decora, Lea. Old quarries near the Mile-end, Montreal.

Anodonta plana, Lea. Rideau Canal near Ottawa City.

Unio luteolus? Lam. var. Common in the St. Lawrence both at Quebec and Montreal.

Unio compressus, Lea. (U. alasmodontinus? Barnes). Assumption River, M. de Villeneuve: Rideau Canal near Ottawa City, Mr. Billings.

Cyclas rhomboidea, Say; and two species as yet undetermined; St. Lawrence, at Quebec.

Pisidium variabile? Prime; and four species not yet determined.

Planorbis armigerus, Say. Trenches in fields near Quebec. This shell belongs to the genus Planorbalina of Haldeman.

Planorbis deflectus, Say. Streams near Quebec.

Limnæa columella, Say. Common in the St. Lawrence near Quebec, at low water, with its variety macrostoma.

Helix rufescens, Muller. Common in the Cove fields, Quebec, but probably introduced.

Helix capsella, Gould. Island of Orleans, but very rare.

Helix dentifera, Binney. St. Lambert, Montreal.

Pupa armifera, Say. Abundant in the Cove fields, Quebec.

Pupa contracta, Say. Island of Orleans.

Shells new to Upper Canada.

From the Welland Canal and its neighbourhood:

Unio gracilis, Barnes.
" coccineus? Lea.
" plicatus, Lesuer.
Paludina integra, Say.
Physa gyrina, Say.
Helix palliata, Say.
" thyroidus, Say.

From the river Thames at Chatham, C. W:

Unio circulus, Lea.

Canadian fresh water shells which occur also on the west side of the Rocky Mountains.

Valvata sincera, Say.
Limnæa solida, Lea. (L. apicina, Lea).
" catascopium, Say.
" jugularis, Say. (L. stagnalis, Linn).
" palustris, Linn. (L. elodes, Say).
" pallida, Adams.
Physa heterostropha, Say.
" hypnorum, Linn. (P. elongata, Say).
Planorbis corpulentus, Say.
" trivolvis, Say.

Of these shells, two are not allowed to be good species ; Limnæa catascopium being considered a variety of L. palustris, and Planorbis corpulentus of P. trivolvis, but in each case they form well marked varieties. My authority for their occurrence west of the Rocky Mountains is Dr. Binney, in his catalogue of the fluviatile gasteropoda of North America, published for the Smithsonian Institution, Washington.

REVIEWS AND NOTICES OF BOOKS.

Voyage d'André Michaux en Canada, depuis le lac Champlain jusqu'à la Baie d'Hudson.—By O. Brunet, Professor of Botany at the Laval University. From the printing establishment of *l'Abeille*, Quebec; 8vo., 27 pages.

This is a notice of the voyages to North America of André Michaux, a native of France, made during the years 1785 to 1786 ; with a sketch of his life. The object of his travels was to make botanical researches and mark the locality of trees and plants peculiar to the country. He has rendered great service to science and deserves the especial consideration of Canadians, for he may be looked upon as the founder of Botany in Canada. The only work having any pretention to a history of Canadian plants which appeared before that of André Michaux was Cornuti's, published in 1635, under the title, *Plantarum Canadensium Historia*, which is far from being a complete flora, and it is besides defective in classification. Charlevoix gives a translation of this work into French, adding a number of plants which had subsequently been discovered. Kalm, the celebrated disciple of Linnæus and Professor of Natural History at Abo, had also visited America in 1749-51, at the request and charge of the King of Sweden ; he extended his visit even to Canada, but the fruits his labours went to enrich the *Species Plantarum* of his great master, where to this day they are to be seen, being identified as his discoveries by the mark of the initial letter K. This would show that Canadian Botany may claim a respectable origin, as by this it is almost contemporaneous with the introduction of the science in modern times,—botany owing its rational momenclature and classification to Linnæus. Michel Sarrazin, an inhabitant of Quebec and Physician to the King under the French dominion, and also a corresponding member of the Academy of Sciences, may be mentioned here as the first Canadian botanist, who became renowned for his discovery of the curious plant which bears his name—*Sarracenia*

purpurea. To the above names may be added those of the Marquis de la Gallissonnière; Dr. Gaultier, after whom Kalm called a small plant, very common in our woods, the *Gaultheria procumbens*, yielding an essential oil used in medicine; P. Boucher, Governor of Three Rivers, and several others.

Michaux was very successful in his searches for the native productions of the vegetable kingdom in Canada, but as the spots where he made his numerous and important discoveries are not always sufficiently described in his works, printed and manuscript, many of the plants have not been met with since, and others are exceedingly rare or still very little known. As most of his time was spent in travelling and herborizing, he did not write much; thinking that the best way he could serve science was by introducing new plants into Europe. Still he has left a history of the oaks of America, published in Paris in 1801, containing a description of twenty species of this tree; besides notes on his travels, which are scattered through the work of his son, who had accompanied him in some of his voyages to America; and a manuscript diary, which the latter presented to the American Philosophical Society of Philadelphia. But his notes and herbaria have furnished materials for a work still more interesting to Canada,—the flora of North America published in Latin by the eminent botanist Claude Louis Richard, in 1803, (the year in which Michaux died,) forming two volumes 8vo, with 52 plates, and in which upwards of 1700 plants are described.

Michaux had already visited England, the Pyrenees and Spain, and had brought with him from Persia a splendid collection of plants and seeds, when the French Government, desiring to introduce into France some of the trees and shrubs growing in North America, charged him with the mission of procuring them.

Instructions had been given him to travel over the United States and collect seeds and roots. He arrived in New-York in November 1785, from whence during two years he made excursions to New-Jersey, Pennsylvania and Maryland. During the first year, he sent to France twelve boxes of seeds, several thousand specimens of trees, and some Canadian partridges, that multiplied at Versailles. He also laid out a garden near Charleston, South Carolina, which was to serve as a starting point for his southern exploration.

In 1787, he made a journey to the Alleghany Mountains. Having ascended the Savannah to its source, and found many beautiful plants and several kinds of oaks, he also proceeded to

the sources of the Tennessee, and thence returned to Charleston, having travelled three hundred leagues through Carolina and Georgia. Many of his notes contain remarks on the most interesting plants which he met with, and even point out the places where they were discovered, in such precise terms that it would still be easy to find them out. In 1788 and the following year, he successively visited Florida, the Bahama Islands, and Virginia. On the 1st of July he arrived at *Washington Court House*, a hamlet in the latter State, which then passed for the first town in that part of the world, though it contained only "twelve wooden houses," and could afford but indifferent cheer to the traveller.

After other excursions to different parts of the Union, attended with more or less success, he came to Canada, in 1792; having spent some seven or eight years in the United States. His first researches in passing from one country into the other, were made on both shores of Lake Champlain, where he noticed many plants,—all mentioned in his flora. Then directing his course towards Montreal, he arrived in this city on the 30th of June, and having remained here only a few days, started for Quebec. On his way down he stopped at Sorel, and there found the *Rhodora Canadensis*. His sojourn in the ancient metropolis of Canada was also of short duration, as it was important he should avoid being overtaken by winter in his progress northward. Having sailed down the St. Lawrence as far as the Saguenay, he landed at Tadousac, the first out-post of the Hudson's Bay Company in that direction, situated at the entrance of the river, and at one time much frequented by the Indians for the purpose of trading; it is now a pretty village. Here he remained a few days, during which he collected some specimens. He next ascended the Saguenay in a bark canoe, and early in August reached Chicoutimi, where the river ceases to be navigable for large vessels. As his way to Lake St. John lay through an almost unexplored wilderness, and as the journey had never been undertaken except by aborigines and a few missionaries, he secured the services of a half-breed and three Indians, with whom he proceeded up the river Chicoutimi and Lake Kinogami, and, after a short portage, through Lake Kinogamichich, down the Aulnet River and Belle Rivière, thus reaching Lake St. John after six days' travelling. At Lake Kinogami he found an aquatic plant, *Lobelia Dortmanna*, which has not since been met with there; its light blue corolla floats upon the surface, while the leaves are entirely submerged. Michaux discovered many specimens on the shores of Lake St. John; and he

saw in the surrounding forest the red pine *Pinus rubra*, the white spruce *Abies alba*, and the cedar, *Thuya occidentalis;* this situation is the farthest north in which these trees had been seen. He remarked that the white pine, *Pinus strobus*, was scattered over a vast extent of country, but not equally so, having seen some on the banks of Lake Mistassin as far north as forty leagues from Lake St. John ; it is however very common two degrees south of that. The *Larix Americana*, or American larch, generally called tamarack in Canada, abounds in the environs of the lake ; the hemlock spruce *Abies Canadensis*, which thrives on the shores of Hudson's Bay, is also abundant.

Our indefatigable voyager then ascended the Mistassin, sometimes called Rivière des Sables, which falls into lake St. John, and which, with the exception of a few short portages, is navigable for canoes a distance of 120 miles. It was then, and still is the route followed by the Mistassin Indians, who dwell near the great Lake Mistassin, and who come to trade at Pointe Bleue, the most northern post in the Canadian territory. Having journeyed for 120 miles up the river he came to the foot of a waterfall. High banks of rock contract the width of the stream, which is precipitated from an elevation of eighty feet over ledges of stone resembling huge steps. Here the intrepid botanist stopped to scramble over the drenched rocks in quest of new specimens pausing now and then to admire the grandeur of the scene.

Continuing his route over the mountains intervening between Canada and the Hudson's Bay Territory, and from whose summit he had a view of the immense valley lying beyond, he reached Lake Mistassin on the 4th September, having halted a few moments to herborize on the shores of the Lac des Cygnes, one of the many lakes which, with numerous streams, water this region. Mr. Brunet, from whose pamphlet, we scarcely need observe, the information contained in this notice is gleaned, gives some interesting details and traditions connected with the great Lake Mistassin, but into these we have neither time nor space to enter. The northernmost point reached by Michaux was one which our author indicates as being on Rupert River, at a short distance from Hudson's Bay ; the Indian guides, dreading the approach of winter, would proceed no farther. He however had an opportunity of determining the exact latitude at which the trees of the north cease to grow, and of recording his observations on the topography of the country. It was while exploring in the neighborhood of Lake Mistassin that he found the pretty species of prim-

rose which he named after the lake, *Primula Mistassinca.* This was his last discovery in that part of North America. Before leaving this continent however, he once more visited the United States, and returned to his native country in 1796. His diary contains interesting information on the climate and vegetable productions of the northern regions visited by him, and the author expresses a hope that the government or some public institution may be induced to cause it to be printed. Mr. Brunet, we understand, intends travelling over the same region, up to Lake Mistassin, with a view to completing the beautiful herbarium which he is making for the Laval University.—*Journal of Education, L. C.*

Iron; its history, properties, and processes of Manufacture By WILLIAM FAIRBAIRN, C.E., LL. D., &c., &c. Edinburgh: A. & C. Black. Montreal: B. Dawson & Son.

This volume is a reprint, with additions and corrections, of the article on the iron manufacture in the eighth edition of the Encyclopædia Britannica.

It endeavours, in a concise history, to trace the progress of the iron manufacture from its earliest beginnings down to the present time, and the various improvements which have been effected in the reduction of the ores, and the subsequent manipulation of the crude iron. The author also gives us analyses of the ores and fuel, so far as they bear on the results of the different processes of manufacture; and shows the reader how much we owe to chemical science, and to the distinguished men who have laboured so industriously and successfully in this important field of research. From his own experience Mr. Fairbairn has been enabled to trace the kinds of furnaces and machinery, from their almost primitive condition, to their present high state of improvement. Chapter I treats of the history of the iron manufacture; then follows an account of the various ores, and of the strata and localities in which they are found. The following chapters treat of fuels; the reduction of ores; the conversion of crude into malleable iron; the mechanical operations of the wrought-iron manufacture; the production of steel; the strength of iron and steel; the chemical composition of iron; statistics of the iron trade; and a brief notice of armour plated ships.

This is the most complete and reliable treatise on this subject in the English language. The eminence of its author as a worker

in iron, and an investigator into its properties, and the processes of its manufacture, render it one of the most complete books that can be consulted. For the general reader, who wishes to be informed about a branch of manufacture and commerce of the highest value and importance to all countries, and for those who are themselves engaged in any department of the iron trade, this work will prove invaluable, and cannot be too strongly recommended.

First Sketch of the New Geological Map of Scotland; with Explanatory Notes. By Sir Roderick I. Murchison, D.C.L., F.R.S., Director-General, and Archibald Geikie, F.R.S., F.G.S., Geologist, of the Geological Survey of Great Britain. Constructed by A. Keith Johnston, Geographer to the Queen. Edinburgh: W. & A. K. Johnston, and W. Blackwood & Sons. London: E. Stamford, Charing Cross.

The leading object of the projectors of this map, as explained by Sir Roderick Murchison, is to lay the basis of a new classification of the rocks of Scotland, with the view of carrying out to their ultimate application the principles first promulgated by Hutton. For this end the careful explorations of Sir Roderick himself, and of the other skilful geologists by which he has been assisted, and to which the science of geology owes in no small measure its rapid development, have been embodied in the map with an amplitude and a distinctness which renders the geological structure of the country patent to the eye, even of the most unitiated, at a glance. To simplify it all the more, there is placed along its margins transverse sections through different parts of the country, showing the general succession of the rock masses. We have first, a generalized section of the crystalline rocks of the Northern Highlands, from the Hebrides across Sutherland, to Brora; secondly, a general section of the country from the north-west promontory of Skye to the Cheviot Hills; thirdly, one from Ben Lomond to the Cheviot Hills; and, fourthly, a detailed section of the structure of Arthur's Seat, as worked out by Mr. Geikie during the progress of the Geological Survey in Scotland. The map, while it presents a complete geological picture of the country, is distinguished from all the other maps that have preceded it, in embracing all the most recent discoveries, and in correcting various errors into which earlier geologists were led while con-

ducting their researches during the dawning of the science, if not also in setting at rest some of the questions upon which different opinions have arisen. Its execution is the production of Mr. Geikie, at the request of and aided by Sir Roderick Murchison, who felt, he says, "aware that in addition to all that had been done in the north, Mr. Geikie's intimate acquaintance with the rocks of the south would render the work of essential service in advancing Scottish geology." There is prefixed to the map an explanatory sketch by Sir Roderick of its various sections, which throws much interesting light upon the progress of discovery; and the topography has been laid down by Mr. A. Keith Johnston, who, as a geographer, has long enjoyed a world-wide reputation. Sir Roderick himself, with the assistance of his colleagues, has completed the map by adding to it many names of places of geological importance. The combined labours of men so distinguished in their respective walks as those to whom we owe the construction of this map, could not fail to prove eminently successful; and we have in it, accordingly, one of the best manuals for the study of the geology of our native country that has yet come under our notice.

Prof. Hall on Receptaculites.

Prof. Hall sends to us a sheet of his forthcoming report on Wisconsin, containing among other matters, notices of several species of the remarkable genus Receptaculites, found principally in the lead-bearing limestones of that State. Two of these had been previously discovered and described by Dr. D. D. Owen, under the generic names *Coscinopora* and *Gelenoides*. Prof. Hall refers both, and four other species found with them, to the genus Receptaculites, and after noticing the new facts in the structure of these fossils stated by Salter in the 1st decade of organic remains, issued by the Canadian Geological Survey, gives the following amended description of the genus.

Generic Characters.—Body consisting of an infundibuliform spreading disc, more or less concave at the centre, depressed-orbicular, and globose. The spreading discoid forms consist of a range of vertical cells in single series; the orbicular discoid forms have radiated curving cells which are directed from the centre or axis towards the margin, their length and curvature depending on the size and form of the mass; the foramnia or cells

in all the forms become larger as they recede from the centre to the periphery, and again become smaller, on the lower side, in the globose forms. Cells cylindrical, contracted below the aperture, and thickened or expanded above, with rhomboidal openings at each extremity. On one side the openings sometimes shows obsolescent rays; the interior walls of the cells are often striated as if preserving the remains of transverse septa.

In all these bodies the cells are arranged on curving lines which diverge from the centre in a constantly enlarging circle; these are crossed by similar lines in an opposite direction, which thus leave quadrangular or rhomboidal spaces, "like the engine turned ornament of a watch." The form of these apertures depends upon the degree of curvature, or upon the form of the mass to which the curvature of the cell lines will conform. In all cases, however, the cell is cylindrical beneath the exterior.

Since the cells vary in size at different distances from the centre, the size of the cells in separate fragments, affords no means, alone, for specific determination.

Regarding the form and mode of growth, I have recognised the following species in the Galena limestone of the lead region.

The species described are

Receptaculites Oweni.
" *Iowensis.*
" *fungosum.*
" *globulare.*
" *infundibulum.*
" *hemisphericum.*

The first of these species sometimes attains to a diameter of 12 inches; and if as Salter supposes, these fossils really belong to Foramenifera, the present observations of Prof. Hall extend in a remarkable manner our ideas of the development and number of these singular creatures in the silurian seas.

Prof. Hall states in the introduction of the report, that large materials have been collected for extended publication on the geology, palæontology, and useful minerals of Wisconsin. We hope that these will be speedily published, and in a manner creditable to the State, and worthy of the talent and skill employed in the work.

J. W. D.

Scientific Farming made easy, or The Science of Agriculture reduced to practice. By THOMAS C. FLETCHER. 2nd edition. London: Routledge, Warne & Routledge. Montreal: B. Dawson & Son.

This is an excellent manual for farmers and although written for England it yet contains directions for the proper cultivation of plants suitable for all countries. It is divided into two parts, the first of which treats of the soil and its fertilizers, the second of cattle feeding; an appendix is added containing general directions on matters of practical chemistry interesting to farmers. The most recent experiments and observations on the application of science to agriculture are given in this volume, in short compass and in a simple intelligible manner. The observations on the feeding of cattle are specially valuable and cannot fail to be of interest to farmers in Canada.

Manual of Agriculture for the School, the Farm and the Fireside. By GEO. B. EMERSON and CHAS. L. FLINT. Boston: Swan, Brewer & Tilestone. Montreal: B. Dawson & Son.

This manual is designed for the instruction of the young. It has been prepared by the directions of the State Board of Agriculture of Massachusetts and is issued under their imprimatur, in the hope that it may be the means of laying the foundation of a complete agricultural education in the district schools of the State. The authors lay no claim to originality, and have availed themselves of all the information, scientific and practical within their reach. It embraces a wide range of topics. The chemistry of the earth, air and water is concisely and accurately stated. The elements of which plants are composed, and the modes of their growth receive ample attention. All the departments of practical farming are treated of, and illustrated with small but clear woodcuts. The chapter on the diseases and enemies of growing plants contains, in a brief form, almost all that can be said of practical use, on these subjects. For the use of teachers there are copious questions at the end of the volume. This book might, with great advantage, be introduced into our common schools in the country. The information which it contains could be easily communicated by any intelligent teacher, whether male or female, to the pupils who generally attend these schools, and could not fail to be both interesting and profitable.

BOTANICAL SOCIETY OF CANADA. KINGSTON.

The eighth meeting of this Society was held in the Convocation Hall of Queen's College on Friday evening, 15th Nov., the Rev. Professor Williamson, LL.D., Vice-President, in the chair.

The chairman opened the proceedings by a short introductory address, in which he alluded to the recent origin of the Society, notwithstanding which, it had already struck its roots deeply into the soil, passed the period of youth, and grown up into a goodly tree, whose branches were spread far and wide. Already, he said, contributions and applications for membership were almost daily being received not only from various parts of Upper and Lower Canada and the adjoining States, but also from Britain, and France, and Italy, and Germany, and even our Australian colonies. And not only so; the Society, young as it was, had already acquired the maturity requisite to enable it to bring forth abundant fruit. Its contributions to science, recorded in the "Annals" of the Society, and in numerous scientific journals of Canada and Britain, were already well known. A Botanic Garden had also been established in Kingston, the first of the kind in Canada, and one that might be expected ere long not only to add to the range of scientific knowledge, but also to yield valuable economic results from the experiments that would be undertaken as to the plants suited to our climate. A public Herbarium was also in course of formation, to which, as in other countries, the student might repair to resolve his doubts in the determination of obscure species. At this season of the year, the plants which form the objects of the botanist's study go to rest; so also the botanist himself withdraws from his pleasant and healthful researches in the fields and woods; but, as there is no real rest in the case of the plant, as the tissues go on developing, and the juices are being elaborated even beneath the snows of winter, so the botanist also does not now pass into a state of inactivity. Our winter meetings begin, the members come together, and an opportunity is afforded of elaborating and making known the results of the summer's work. The chairman concluded by alluding to the valuable aid that had been derived from Prof. Gray and Sir Wm. Logan in forwarding the objects of the Society, and expressed a hope that our Provincial Government would view the labors of this Society in the same favorable light in which they were viewed by scientific men, and give to the Society that countenance

and aid which the Governments of other countries did not fail to bestow upon similar institutions.

Numerous donations to the Botanic Garden to the Herbarium, and to the library were announced.

Dr. Dickson, Professor of Surgery, moved a vote of thanks to the various donors. He alluded to the valuable character of some of the donations, such as those of Professor Tuckerman, and especially of Sir William Logan and Prof. Asa Gray of Harvard. Sir William had sent to the Society the various collections of plants that had been made at different times by the officers of the Geological Survey of Canada.—Many of these were from localities inaccessible to ordinary collectors, and were of great interest. Independent, however, of the intrinsic value of these very large collections, we must regard the compliment paid to us by Sir Wm. Logan in making us the custodiers, as an indication of his confidence in the ability of our Society to sustain the character of botanical science in the country. Professor Gray's invaluable donation from the Cambridge Garden could scarcely be overestimated, for it, along with the donations of our local horticulturists, had enabled us in a short time to form a Botanic Garden and the force of our example in this respect was already beneficially felt by other cities in Canada. Coming at such a time, when the country is distracted by civil war, we must appreciate Professor Gray's donation as a special mark of favor, and accord our thanks with more than ordinary fervour.

Prof. Lavell seconded the motion, and alluded particularly to the donations of trees, shrubs and plants that had been made by our local horticulturists. Thanks were cordially voted to all the donors.

A letter was read from J. Thayer, junr., Secretary of the Montreal Agricultural and Horticultural Society, stating that the members of that society were desirous of establishing a Botanic Garden in Montreal, and requesting any reports, documents, and suggestions. The secretary was authorised to send the "Annals," and other publications, to the Montreal Society, as published, and to afford any additional information that might be required.

Various papers were read—we select the following.

REMARKS ON A NEW CULINARY VEGETABLE, THE PARSNIP CHERVIL, BY MRS. PROF. WEIR

On 30th August, 1861, Messrs. Vilmorin, Andrieux & Co.. the eminent Seedsmen of Paris, issued a circular, in which they re-

commend the cultivation of this root, on the ground that it has acquired new importance from the fact that the disease has attacked all the early varieties of Potato.

It is in fact one of the best of those recently introduced, being desirable for its feculent qualities, its flavour (which is something between that of a chesnut and a potato), and also on account of its productiveness, yielding as it does six tons an acre.

Another merit of this vegetable is that it comes into use early in the season; in the beginning of June the roots are formed, and they keep good until the April following. It requires the same treatment as the potato, and, like it, can be cooked in a variety of ways.

The cultivation of it is very simple. It ought to be sowed in the month of September or October, either in lines or scattered as you would carrot seed, care being taken to press down the soil slightly after it is sown.

We ought to remark at the same time that, unlike the potato, which thrives best in a light, dry or sandy soil, the Chærophyllum bulbosum is most successfully cultivated in rather damp soil which has previously been prepared and manured.

If sown later than the period above mentioned, it will be necessary to use seed which has been kept for some time in a layer of earth or damp sand; without which precaution it is not likely to germinate till the year following. The roots are gathered in the month of July, and preserved in the same way as potatoes, care being taken to turn them occasionally to prevent their deteriorating.

This root has received various names, such as *Myrrhis bulbosa*, Spreng, *Scandix bulbosa*, of some German botanists, *Chœrophyllum bulbosum*, L. But the name by which it is likely to be know in common use is Parsnip Chervil.

Professor Lindley says it is regarded by French gourmands as "un vegetable des plus delicieux," and he agrees with them. It is in fact he says, uncommonly good to eat, very like a boiled Spanish chesnut, without its crispness or hardness. In Europe, as has already been remarked, it is sown in September or October, but it will brobably be found better to sow it in spring in Canada. The plant is a native of Europe, and was cultivated in England by Mr. Philip Miller so long ago as 1726, but as a botanical curiosity only. Again, a few years ago, it was proposed for cultivation, but the roots were found to be too small to be of much use. Since

then, however, it has been improved by cultivation; the roots are figured as of the size and nearly the shape of an undersized early horn carrot. It is likely, therefore, to form a substantial addition to our culinary crops.

It has been stated in the Gardeners' Chronicle that the Royal Horticultural Society bought up for their members all the good seed that was procurable, and this was to be distributed in small packets last month. It will, therefore, be satisfactory to the members of the Botanical Society of Canada, to learn that our Society had previously secured a supply of seeds, which will be distributed to members in good time for sowing.

MISCELLANEOUS.

Note on Indian Beads presented to the Natural History Society by James Robb, Esq., Mining Engineer, &c.

In a memorandum accompanying these specimens, they are said to have been taken from an old burying place in a small island in the St. Lawrence near Brockville. They were found with two skeletons, placed in a sitting posture and facing each other, buried under four feet of sand resting on a floor of clay, which was supposed to have been artificial. The beads and a sea shell were in a heap under three flat stones placed on edge, and converging at the top. These stones were of a quality suitable for hones.

The beads are made of native copper, which has been beaten out and then doubled into thick rings, about a quarter of an inch in diameter externally. They are quite rough but rather uniform in size and shape. The shell appears to be the common *Purpura lapillus* of the American coast, smoothed externally, and with the apex ground off. It has no doubt been strung with the beads. It is curious thus to find at a place half-way between the copper regions of Lake Superior and the sea coast, the products of both carried from their distant sources, and used for ornamental purposes by the aborigines.

J. W. D.

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MONTHLY METEOROLOGICAL REGISTER, ST. MARTINS, ISLE JESUS, CANADA EAST, (NINE MILES WEST OF MONTREAL,) FOR THE MONTH OF OCTOBER, 1861.

Latitude, 45 degrees 32 minutes North. Longitude, 73 degrees 36 minutes West. Height above the level of the Sea, 118 feet.

BY CHARLES SMALLWOOD, M.D., LL.D.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of, in tenths.	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &c. &c. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2 p. m.	10 p. m.
1	30.315	30.250	30.160	40.0	60.9	50.6	.232	.310	.309	.96	.60	.85	S. W.	S. S. E.	S. by W.	4.80	2.0	....	....	Fog.	Clear.	Cirr Str. 8.
2	29.952	29.748	29.474	46.4	74.3	60.4	.286	.469	.456	.92	.57	.88	S. S. E.	S. by E.	S. by E.	41.00	2.0	....	....	C. C. Str. 6.	Cu. Str. 6.	" 9.
3	678	721	903	61.0	64.0	50.2	.419	.314	.265	.85	.53	.75	W. by S.	W.	N. N. W.	220 80	2.5	....	....	Clear.	C. C. Str. 6.	Clear.
4	964	934	988	43 0	60.0	46.1	.224	.456	.286	.79	.88	.92	S. S. E.	S. S. E.	S. S. E.	22.90	3.5	Inapp.	....	Cum. 9.	Cu. Str. 10.	"
5	796	719	758	40.0	41.6	43.0	.225	.251	.261	.91	.96	.95	N. E by E.	N. E. by E.	N. W.	242.90	5.0	0 836	....	Rain.	Rain.	Rain.
6	629	647	700	51.0	57.9	55.5	.354	.429	.405	.96	.91	.94	S. S. E.	S. S. E.	N. E. by E.	94 30	4 0	....	....	Cu. Str. 10.	Cu. Str. 8.	"
7	924	932	30.020	50.0	53.1	48.2	.297	.295	310	.85	.73	.91	N. E. by E.	N. E. W. E.	S.	147.10	4 5	0.523	....	Cu. Str. 4.	" 8.	Cu. Str. 10.
8	30.021	30.010	074	46.4	53.0	45.1	.260	.248	.275	.88	.86	.91	W. S. W.	S. E.	S. S. W.	12.80	3.5	0.420	....	Rain.	" 6.	Clear.
9	150	127	200	41.0	68.2	48.7	.235	.476	.329	.91	.69	.94	S. S. W.	S.	S. E.	0.30	3.0	....	....	Fog.	Clear.	Clear.
10	120	100	020	36.7	68.4	49.6	.236	.536	.315	.95	.77	.89	S. S. E.	S. S. E.	E.	1 20	3.0	....	....	Fog.	"	Clear. Aurora B. Streamers.
11	29.851	29.814	29.701	43.0	49.2	47.3	.254	.322	.316	.92	.92	.97	E.	N. E. by E.	N. E. by E.	73.49	4.0	1.236	....	Cu. Str. 8.	Rain.	Cu. Str. 10.
12	604	406	.412	50.0	68.4	50.4	.341	.606	.353	.96	.86	.93	W.	W. S. W.	S. S. E.	88.80	5.0	1.694	....	Rain.	C. C. Str. 6.	" 10.
13	401	394	521	43.6	52.0	46.3	.254	.208	.280	.92	.53	.89	W. S. W.	W. N. W.	W.	229.80	5.5	0.044	....	Cu. Str. 8.	Clear.	Clear.
14	682	624	701	41.9	59.0	49 0	.228	.380	.290	.86	.76	.82	W. S W.	W. S. W.	S. W.	276 50	4.5	....	....	Cu. Str. 8.	Cu. Str. 4.	Cum. 2.
15	790	814	972	40.1	58 4	45.0	.225	.394	.245	.91	.82	.80	S. W.	S. W.	S. W.	155.90	4.0	....	....	Clear.	Clear.	Clear.
16	30.070	954	884	35.1	50.9	46.1	.183	.277	.286	.90	.75	.92	E. S. E.	E. N. E.	N. E. by E.	54 40	3.5	....	....	Cu. Str. 10.	Cu. Str. 9.	Cu. Str. 10.
17	29.801	854	850	45.1	68.6	56.1	.275	.606	.391	.92	.88	.87	E. S. E.	S. S. E.	S. by E.	20.40	2 5	....	....	" 10.	C. C. Str. 4.	Cir. Cum. 6.
18	710	670	762	54.1	49.9	45.6	.390	.315	.293	.93	.89	.96	S. S. E.	N. E. by E.	N. E. by E.	159 90	3.5	0.396	....	" 6.	" 8.	Cu. Str. 10.
19	697	511	497	44 1	48.1	45.2	.265	.310	.275	.92	.92	.92	N. E. by E.	N. E. by E.	W.	158 60	5.5	0.014	....	Rain.	Cu. Str. 4.	" 4.
20	567	814	997	44 2	48 2	35.0	.265	.285	.175	.92	.85	.89	W.	W. N. W.	W. by N.	430 98	5.5	Inapp.	....	Cu. Str. 8.	" 6.	Clear.
21	30.151	30.160	30.172	26.0	47.0	55.6	.111	.290	.177	.81	.90	.85	W. S. W.	S. S. W.	E. S. E.	32 80	2.5	....	....	Clear. Hard Frost.	Clear.	"
22	040	29.840	29.830	28.4	56.9	51.0	.129	.275	.309	.82	.60	.85	N. E. by E.	E. S. E.	S. S. E.	88 80	2 5	Inapp.	....	" "	Cu. Str. 8.	Cirr. Str. 8.
23	29.461	347	449	50.1	54.2	41.0	.341	.341	.235	.96	.83	.91	S. S. E.	W. S. W.	S. by E.	230.20	5.0	Inapp.	Inapp.	Cu. Str. 10.	Rain.	" 10.
24	750	891	30.200	31.3	39.0	29.0	.149	.158	.129	.85	.68	.82	W. by S.	W. by S.	S. W.	564 90	5 0	Inapp.	....	" 4.	C. C. Str. 4.	Clear. Aurora Borealis.
25	30.300	30.257	170	21.4	45.0	57.0	.090	.275	.177	.79	.92	.85	S. S. E.	S. E.	S. S. E.	48 70	3.0	....	....	Clear.	" 6.	Cirr. Str. Faint Aurora Borealis.
26	080	001	29.912	36.0	51.6	46.7	.162	.348	.305	.84	.93	.96	S. S. E.	S. S. E.	S. W.	65 70	3.5	0.166	....	Cu. Str. 10.	Cirr. Str. 10.	Rain.
27	100	094	30.101	35.0	47.1	32 1	.183	.273	.142	.90	.85	.84	W.	N. by E.	N. W.	128 10	3.5	....	....	" 4.	Cirr. 4.	Clear. Aurora Borealis at 4 a.m.
28	066	009	29.950	30.0	41.0	33 0	.142	.111	.156	.88	.44	.85	N. N. W.	S. W.	S. W.	49.60	3.0	....	....	Clear.	Clear.	"
29	29.750	29.453	541	28.0	86.2	40.5	.155	.315	.197	.88	.71	.78	S. W.	S. W. by S.	S. S. E.	75.00	2.5	....	....	"	"	"
30	301	357	400	30.1	44 0	41.0	.156	.248	.241	.85	.88	.95	N. E. by E.	N. N. E.	N. E. by E.	11.70	5.5	Inapp.	....	"	C. C. Str. 6.	Cu. Str. 10.
31	534	660	876	39.0	46 1	39.4	.216	.262	.210	.91	.86	.86	N. E. by E.	S. W.	W. S. W.	159.90	3.0	0.014	....	Cu. Str. 10.	Cu. Str. 10.	" 4. Aurora Borealis.

REPORT FOR THE MONTH OF MOVEMBER, 1861.

Day of Month.	Barometer—corrected and reduced to 32° F. (English inches.)			Temperature of the Air.—F.			Tension of Aqueous Vapour.			Humidity of the Atmosphere.			Direction of Wind.			Horizontal Movement in 24 hours. In miles.	OZONE. Mean amount of	RAIN. Amount of, in inches.	SNOW. Amount of, in inches.	WEATHER, CLOUDS, REMARKS, &C. &C. [A cloudy sky is represented by 10, a cloudless one by 0.]		
	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.	6 a. m.	2 p. m.	10 p. m.					6 a. m.	2. p. m.	10 p. m.
1	30.100	30.142	30.167	30.1	47.0	36.6	.148	.208	.149	.89	.66	.71	W. S. W.	S. W. by S.	N. E. by E.	61.50	2.0	....	....	Clear.	C C. Str. 8.	Cu. Str. 4.
2	201	29.940	29.854	30.1	34.2	36.1	.148	.155	.191	.89	.79	.90	N. E. by E.	N. E. by E.	N. E. by E.	258 70	2.5	....	Inapp.	Cu. Str. 10.	Cu. Str. 8.	Rain.
3	29.497	421	387	35.1	42.1	41.0	.183	.244	.241	.90	.91	.95	N. E. by E.	N. E. by E.	N. E. by E.	487.00	4.0	0.214	....	C. C. Str. 10.	Rain.	"
4	371	412	558	40.0	48.3	39.0	.248	.242	.216	1.00	.74	.91	S. S. E.	S. by E.	S. S. E.	98 40	4 5	0.112	....	Light Rain.	C. C. Str. 8.	Cu. Str. 4.
5	567	521	567	34 2	47.0	43.0	.155	.258	.281	.79	.81	.88	S. S. E.	E. S. E.	N. E	46.40	2.0	....	....	Cu. Str. 10.	Cu. Str. 10.	" 10.
6	500	465	142	37.0	44.0	44 0	.206	.265	.266	.95	.92	.93	N. E. by E.	N. E. by E.	N. W.	87 20	1.5	....	....	Fog.	" 10.	Rain.
7	574	567	644	39.2	45.7	36.0	.216	.198	.156	.91	.65	.75	W. S. W.	W.	W. S. W.	209.50	1 5	....	....	C. C. Str. 8.	" 4.	Clear.
8	600	567	755	31.9	41.5	33.2	.144	.126	.156	.80	.49	.84	W. by S.	S. W. by S.	S. E. by E.	217.30	1.0	....	....	Clear. Au. Bo. 3 a.m.	Clear.	Cu. Str. 10.
9	561	642	701	32.1	41.4	35.0	.130	.190	.149	.74	.73	.74	S. E.	S. S. E.	W.	41.50	1.0	Inapp.	....	"	Cu. Str. 10.	" 10.
10	894	30.001	981	23.0	43.0	33.0	.106	.127	.154	.86	.47	.86	S. by W.	E.	S. E.	21.70	1 0	....	....	Clear. Au. Bo. 3 a.m.	C. C. Str. 4.	C. C. Str. 10. Incp L. Halo 7 p.m.
11	477	29.459	612	38.9	42.0	40.0	.216	.233	.210	.91	.95	.86	S. S. E.	E. S. E.	W. S. W.	220 30	3 0	0.673	....	Cu. Str. 10.	Rain.	Cu. Str. 8.
12	30.042	30.047	30.120	32.5	57.5	32 0	.162	.110	.149	.89	.49	.89	W. S. W.	W. by N.	N. W.	397 40	2.5	0 014	....	" 10.	C. C. Str. 8.	" 9.
13	29.931	29.930	29.801	27.5	34.2	33.0	.111	.158	.150	.75	.71	.89	E.	E. S. E.	S. by W.	15.80	2.0	....	....	C. C. Str. 8.	Cu. Str. 10.	" 9.
14	754	746	780	31.0	38 1	30.0	.136	.144	.136	.78	.63	.83	S. W.	S. W.	S. W.	333.40	1 5	....	....	Str. 4.	Cirr. 2.	Cirr. Str. 2.
15	589	450	484	25.5	33.0	30.0	.111	.131	.148	.71	.70	.89	W. N. W.	W. N. W.	W. by N.	241.90	2.0	....	....	Cu. Str. 10.	Cu. Str. 2.	Snow.
16	357	519	617	27.3	38 4	37.3	.129	.186	.157	.88	.81	.71	S. S. W.	S. W.	S.	229.20	4.5	....	1.10	" 10.	Snow.	Cu. Str. 8.
17	650	657	670	31.1	39.4	30.0	.142	.178	.117	.84	.78	.72	S. by W.	S. by E.	W. by N.	236.60	2.0	....	0.46	" 10.	Clear. Solar Halo.	" 4.
18	824	797	900	25.9	40.1	31.0	.111	.160	.150	.81	.64	.80	S. W. by W.	W. S. W.	W. S. W.	48.10	2.0	....	....	C. C. Str. 6.	Cirr. 4.	Clear.
19	30.026	30.147	30 190	22 3	35.2	26.2	.084	.127	.088	.71	.62	.62	W.	E. S. E.	S. S. E.	37.50	1.5	....	....	Clear.	Clear.	"
20	166	009	020	22 0	36.6	27.6	.084	.129	.105	.71	.61	.70	N. E. by E.	N. by E.	N. E. by E.	134 10	1.0	....	....	"	"	"
21	29.987	29.996	101	25.0	34.0	27.2	.100	.155	.117	.75	.79	.83	N. E. by E.	N. E. by E.	S. W. by S.	172.50	2.0	....	....	Cu. Str. 6.	C. C. Str. 6.	Cirr. 4.
22	30.097	937	29.800	24 3	40.4	27.4	.101	.160	.111	.79	.64	.75	N. E. by E.	N. E. by E.	N. W.	61 60	2.5	....	....	Clear.	Clear.	Clear.
23	29.050	631	540	27.6	33 4	32.0	.123	.102	.168	.82	.84	.89	N. E. by E.	N. E. by E.	N. E. by E.	161.10	4 0	....	1.92	C. C. Str. 8.	Snow.	Snow.
24	261	314	140	32.0	33.4	34 2	.168	.162	.177	.89	.84	.88	N. E. by E.	S. E.	S. S. E.	247.90	5.0	....	4.42	Cu Str. 10.	"	Cu. Str. 10.
25	504	542	640	27.6	36.2	26.1	.123	.170	.105	.82	.80	.75	E.	E.	S. W.	18.90	2.5	....	....	" 10.	C. C. Str. 10.	Clear.
26	700	779	900	25.1	35.2	24.3	.105	.162	.111	.80	.79	.86	S. E.	S. W.	S. S. W.	48.80	2.0	....	....	" 10.	Cu. Str. 10.	Cu. Str. 10.
27	918	990	803	22.4	28.9	27.1	.095	.093	.111	.79	.59	.75	E. by N.	N. E. by E.	N. E. by E.	104.20	2 5	....	....	"	"	"
28	774	834	876	30.4	35 0	28.2	.142	.142	.117	.84	.70	.76	S. E. by E.	S. by E.	S. W.	135 80	3 5	....	1.30	Snow.	" 10.	" 4.
29	594	480	500	27 0	32.0	31.1	.117	.162	.135	.82	.80	.89	E.	E. S. E.	S. S. W.	129.00	4.8	Inapp.	1.64	"	Snow.	" 10.
30	299	548	662	29 6	37.3	29.7	.136	.164	.136	.85	.76	.83	W.	S. W.	S. S. W.	38 40	4.8	....	0.67	Cirr. Str. 10.	"	" 10.
...	......	......	......	...	......	......	......	......	......	......	......	......	......	......	......	......	......	....	....	....	....	....

REMARKS FOR OCTOBER, 1861.

Barometer .... Highest, the 1st day, 30·315 inches.
Lowest, the 30th day, 29.301 "
Monthly Mean, 29.876 "
" Range, 1.014 "

Thermometer ... Highest, the 17th day, 68°6.
Lowest, the 22nd day, 26°2.
Monthly Mean, 46°64.
Monthly Range, 42°4.

Greatest intensity of the Sun's rays, 98°0.
Lowest point of Terrestrial radiation,—24°0.
Amount of evaporation, 1·17 inches.
Mean of Humidity, .843.

Rain fell on 16 days, amounting to 5.370 inches; it was raining 69 hours and 30 minutes.
Snow fell on 1 day inappreciable.
Most prevalent wind, the S. S. E.
Least prevalent wind, the S.
Most windy day the 20th day, mean miles per hour, 17.54.
Least windy day the 9th day, mean miles per hour, 0.01.
Aurora Borealis visible on 5 nights.
The Electrical state of the Atmosphere has indicated moderate intensity.
1st Snow of the Season fell on the 24th day.

REMARKS FOR NOVEMBER, 1861.

Barometer. .. ... Highest, the 2nd day, 30.201 inches.
Lowest, the 39th day, 29.299 "
Monthly Mean, 29.714 "
Monthly Range, 0.302 "

Thermometer. Highest, the 4th day, 48°3.
Lowest, the 22nd day,—19°7.
Monthly Mean, 33°60.
Monthly Range, 28°6.

Greatest intensity of the Sun's rays, 77°7.
Lowest point of terrestrial radiation,—17°4.
Mean of humidity, ·787.
Rain fell on 6 days, amounting to 1·023 inches, it was raining 32 hours, 52 minutes.

Snow fell on 8 days amounting to 11·51 inches. It was snowing 54 hours and 29 minutes.
Most prevalent wind, N. E. by E.
Least prevalent wind, S.
Most windy day, the 3rd day; mean miles per hour, 2.25.
Least windy day, the 12th day; mean miles per hour, 0.65.
Aurora Borealis visible on 3 nights.
The Electrical state of the Atmosphere has indicated feeble intensity.
Snow Birds (*Plectrophanes Nivalis*) 1st seen 17th day.
Imperfect Solar Halo on the 18th day.
Imperfect Lunar Halo on the 10th day.
Crows left here about the 7th day.